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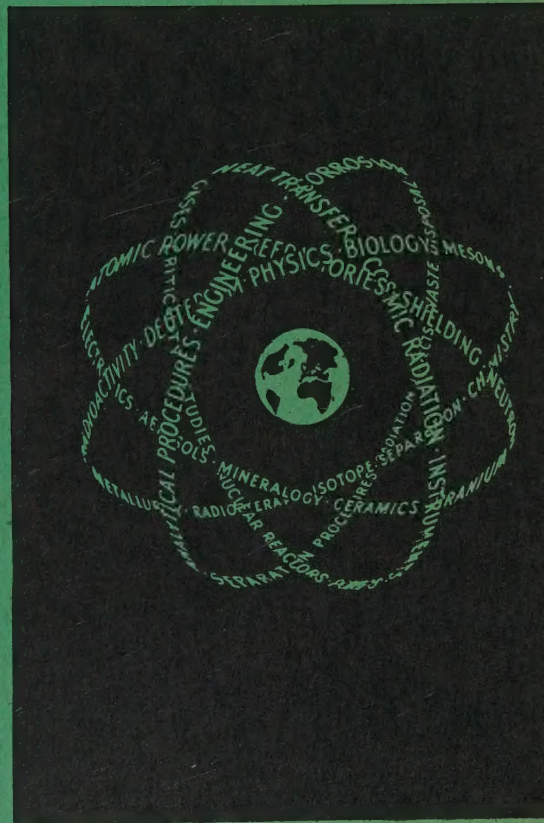
# NUCLEAR SCIENCE ABSTRACTS

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*August 31, 1959*

**Volume 13    Number 16**

**Abstracts 14126 - 14946**



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# NUCLEAR SCIENCE ABSTRACTS



Volume 13 Number 16

August 31, 1959

## GENERAL

**14126** JPRS(NY)-828

ROLE OF NUCLEAR POWER STATION IN A POWER SYSTEM. W. Ney. Translated from *Przegląd Elektrotech.* 34, 61-6 (1958). 15p. (PB-141319-T). \$0.50 (OTS).

Factors determining the distribution of nuclear power stations are discussed. The danger of radioactive contamination is reported. A comparison is presented of power-generation costs in coal-burning and nuclear power stations. (W.L.H.)

**14127**

AGE DETERMINATIONS BY RADIOCARBON. W. Van Pée, E. Crèvecoeur, and P. Capron (Université, Louvain, Belgium). *Bull. classe sci., Acad. roy. Belg.* 44, 994-1007 (1958). (In French)

Radiocarbon allows the absolute dating of carbon samples. The apparatus necessary and the successive operations in dating a sample are described. Some results obtained by this method are given. (tr-auth)

## BIOLOGY AND MEDICINE

**14128** AD-149938

California. Univ., Los Angeles.

EFFECT OF IONIZING RADIATION ON THE NUTRITIVE AND SAFETY CHARACTERISTICS OF FOODS. Progress Report [for] April 1, 1957-September 15, 1957. J. F. Mead and W. H. Griffith. Sept. 15, 1957. 26p. Contract DA-49-007-MD-579.

The feeding of irradiated bacon and fruit compote to rats has passed the 12 week stage. There is no apparent difference between the animals on the control or the experimental diets. The fatty acid-hydroquinone antioxidant which was described in our last report was not acutely toxic to mice when fed at a 3% level in the diet for 16 days. The  $\gamma$ -irradiation of 0.1 m aqueous solutions of *t*-butyl hydroperoxide caused disappearance of approximately 20% of the peroxide, and nearly 70% of the altered peroxide has been shown to be a *vic*-glycol or products derived from it. Studies that measured the intestinal glutathione level of weanling female rats revealed that there was no change due to feeding a diet containing highly oxidized soybean oil. (auth)

**14129** AD-150585

New York. State Univ. Veterinary Coll., Ithaca. Lab. of Radiation Biology.

DEPOSITION AND REMOVAL OF RADIOISOTOPES FROM THE BODY. Quarterly Progress Report [for]

October 1, 1957-January 1, 1958. C. L. Comar and R. H. Wasserman. Jan. 1, 1958. 7p. Contract DA-49-007-MD-897.

The first work under this project is designed to provide information on the possibilities of reducing the body burden of radiostrontium under conditions of daily ingestion. Sheep and goats will be used as test animals. Modification of facilities and acquisition of special materials for work under this contract is proceeding. A survey of pertinent literature has been essentially completed. A pilot study with rats has been started to show the influence of dietary calcium and phosphate levels on the retention of radiostrontium and radiocalcium. (C.H.)

**14130** AD-200543

Ohio State Univ. Research Foundation, Columbus. EFFECT OF X-IRRADIATION ON HUMAN ERYTHROCYTE METABOLISM. Annual Report [for] August 1, 1957-July 31, 1958. Milton A. Lessler. July 1958. 16p. RF Project 513, Report No. 11. Contract DA-49-007-MD-293.

Studies of the metabolism of human erythrocytes stored under standard blood bank conditions and x irradiated *in vitro* with lethal and super-lethal doses were carried out. These studies indicate that erythrocytes stored in ACD solution have slightly lower levels of respiration than unstored cells, but show no progressive changes in respiration with storage. A comparison of unirradiated and irradiated samples indicated that x irradiation caused slight increases in the respiration of stored erythrocytes, but 700 r and 1400 r did not cause significant damage to the "Blood Bank" stored cells. Hemolysis studies indicated that freshly drawn and 48-hour-stored red cells are not damaged by radiation doses up to 700 r. A kinetic analysis of red cell glycolysis indicated that maximum velocities were approximately equal at normal blood values of glucose, but at higher or lower glucose levels inhibition of glycolysis was evident following 700 r. (auth)

**14131** AD-201602

Syracuse Univ., N. Y. Biological and Food Research

Center and Syracuse Univ., N. Y. Research Inst. THE CHEMICAL ENHANCEMENT OF BACTERIAL RADIOSENSITIVITY IN THE RADIATION STERILIZATION FOODS. Report No. 12 (Final) [for] September 1, 1955-December 31, 1957. A. W. Phillips. 72p. Project No. 7-84-01-002. Contract DA-19-129-QM-524.

A number of compounds were found to be synergistic or complementary with x irradiation in the inactivation of spores of *Bacillus thermoacidurans*, *B. subtilis*, and *B. cereus*. The synergism involving ethylene oxide was studied in some detail using *B. thermoacidurans* and *B.*



*subtilis*. Propylene oxide showed a similar synergistic effect. Also, alpha-amino-n-butyric acid was synergistic with radiation on *B. cereus* spores. A number of compounds were complementary with x irradiation in the inactivation of spores. For instance, sorbic acid, sodium diacetate, 1,2-propanediol, benzylalkonium chloride ("Roccal"), malonic acid, maleic acid, sodium desoxycholate. *B. subtilis* spores were more radio-resistant than those of *B. cereus* or *B. thermoacidurans*; the respective  $D_0$  values were about 150,000, 80,000, and 50,000 rads. Fluid milk and fresh meats were sterilized by combined radiation and dilute ethylene oxide treatment using 100,000 rads or less of ionizing radiation. While the sterilized foods were normal in appearance and taste, no attempt was made to determine their wholesomeness. Indeed, the main objective of this phase was the establishment of a bacteriological baseline; the selection of the most appropriate agent will require further investigation. Propylene oxide should be explored since it too is volatile and its glycol is metabolizable and harmless, whereas ethylene glycol is toxic. The need for additional knowledge concerning factors involved in the radiation sensitivity of micro-organisms has been evident throughout this investigation. More information on the mechanism of radiation resistance, especially in bacterial spores, should be most helpful to the radiation preservation program. (auth)

**14132** AD-203085

Southern Research Inst. Birmingham, Ala.  
DETERMINATION OF EFFECT OF PACKAGING MATERIALS ON THE PROPERTIES OF IRRADIATED FOODS. Progress Report No. 9 [for] January 20, 1958 - March 19, 1958. Charles E. Feazel. 36p. Project No. 7-84-01-002. Contract DA19-129-QM-752.

The following combinations of foods and plastic packages were irradiated and studied during this reporting period: ground beef packaged in Polyflex 100, polyethylene-coated bleached Kraft, the polyethylene-coated unbleached Kraft; frankfurters in Scotchpak; ground pork in Scotchpak, polyethylene-cellophane, and coated unbleached Kraft; milk in Scotchpak; catsup in Scotchpak; boiled-egg custard in Scotchpak and polyethylene-cellophane; salami in Scotchpak, polyethylene-cellophane, coated unbleached Kraft, and polyethylene-aluminum-Mylar-polyethylene; pork sausages in unplasticized Krene; and partially-baked rolls in coated unbleached Kraft. Rolls received 0, 0.465, and 0.93 megarad of gamma radiation. All other combinations of foods and packages received 0, 0.93, 2.79, and 5.58 megarad of gamma radiation. (auth)

**14133** AD-203370

Columbia Univ., New York.  
NUTRITIONAL AND BIOCHEMICAL EFFECTS OF IRRADIATION FROM COBALT-60. Final Report [for] May 1, 1954 to September 30, 1956. C. G. King, T. R. Nolan, B. H. J. Przybielski, and R. R. Becker. 25p. Contract DA-49-007-MD-550.

The effects of feeding a partially irradiated diet to rats for a period of 13 months were studied. No significant differences in growth, reproductive performance, or pathology were found in control animals and those receiving irradiated butterfat ( $3.0 \times 10^6$  rep) and supplemented with vitamin E. The oxidation of aqueous hydroquinone solutions by  $\text{Co}^{60}$  gamma rays was studied and interpreted in terms of the mechanism of oxidation of ferrous iron under similar conditions. Rates, under conditions of zero order kinetics, were determined for the disappearance of reactant and oxygen and the appear-

ance of products and hydrogen peroxide in the 2,5-dimethyl-p-hydroquinone and 2,5-dichloro-p-hydroquinone systems. (auth)

**14134** AD-203422

Baylor Univ., Houston, Tex. Coll. of Medicine and Jefferson Davis Hospital, Houston, Tex.

A STUDY OF THE EFFECTS OF TOTAL AND PARTIAL BODY RADIATION ON IRON METABOLISM AND HEMATOPOIESIS. Progress Report for Period June 1, 1958 - August 31, 1958. V. P. Collins, C. T. Teng, and W. D. West. 14p. Contract DA-49-007-MD-428.

In 1950, a report by Hennessy and Huff indicated a precise quantitative relationship for whole body radiation and radio-iron turnover studies in rats. Over the past several years, observations on humans receiving therapeutic total body radiation demonstrated that doses in the clinical range did depress iron turnover rates but a useful quantitative relationship could not be established. For this reason, the work of Hennessy and Huff has been repeated in an attempt to duplicate the results. This experiment failed to confirm the findings of Hennessy and Huff but results are in agreement with clinical observations. Two additional patients have received total body radiation in fractionated doses; they are still under observation. Additional experiments in extra-corporeal radiation of blood are nearing completion. (auth)

**14135** AD-204353

Johns Hopkins Univ., Baltimore. McCollum-Pratt Inst.  
EFFECTS OF HIGH LEVELS OF IONIZING RADIATION ON ANIMAL TISSUES. Progress Report No. VIII [for] September 1, 1957 - February 28, 1958. Kenneth J. Monty and Paul B. Pearson. 10p. Contract DA-49-007-MD-631-0. I.

A survey of the nature and amounts of fat-soluble carbonyl compounds in several irradiated meats has been nearly completed. The results of these experiments are presented in summary. Two types of carbonyl formation discussed include the breakdown of plasmalogens and the peroxidative degradation of unsaturated fatty acids. The former leads chiefly to the production of long chain fatty aldehydes. The latter results in the accumulation of a wide variety of aldehydes and ketones with chain lengths of from 3 to 10 carbon atoms. Experiments are underway to examine the metabolism and the safety characteristics of representative carbonyl compounds. Experimental design is discussed, and some preliminary findings reported. The only detrimental effect noted to date was the apparent retardation by a fatty aldehyde of fat absorption in the rat. (auth)

**14136** AD-205118

Southern Research Inst., Birmingham, Ala.  
DETERMINATION OF EFFECT OF PACKAGING MATERIALS ON THE PROPERTIES OF IRRADIATED FOODS. Report No. 10 (Final) [for] September 20, 1956 to March 19, 1958. Charles E. Feazel. 83p. Project No. 7-84-01-002. Contract DA19-129-QM-752.

The object of this work on radiation-preservation of foods was to study the interaction between packaging materials and foods when they were irradiated in contact with each other. Foods were packaged in the films to be tested, irradiated, and both were observed before and after storage periods up to two months. From tests actually performed, the following packages appear to be the most desirable for the foods: Scotchpak for beef, green pole beans, cheese, pork, tomato juice, tomato catsup, milk, and egg custard; a laminated film of



polyethylene-aluminum-Mylar-polyethylene for sausages, orange juice, and salami; and Saran 853.11 for partially-baked rolls. In some cases, experience suggested that films other than those tested might have been better. These suggested combinations were: Polyethylene-aluminum-Mylar-polyethylene for meats; a film which might be made of laminated Saran and polyethylene for beans, partially-baked rolls, and cheese. (auth)

**14137** AD-205119

Southern Research Inst., Birmingham, Ala.  
**DETERMINING THE FUNCTIONAL PROPERTIES OF FOOD CONTAINERS USED FOR FOODS IRRADIATED IN COMBINATION WITH MODEL FOOD SYSTEMS.**  
 Report No. 10 (Annual) [for] September 25, 1956-March 24, 1958. Charles E. Feazel. 90p. Project No. 7-84-01-002. Contract DA19-129-QM-759.

The object of this investigation on the radiation preservation of foods was to study the interaction between plastic packages and model foods when they were irradiated together. Water solutions of sodium chloride, acetic acid, and sucrose presented relatively few difficulties and could be packaged in Scotchpak and several other combinations of polyethylene. Methionine solution was a little more difficult, but was successfully packaged in polyethylene-cellophane. Salad oil and 5% lactic acid solution were the most difficult and could be held only in Scotchpak and a laminate of polyethylene-aluminum-Mylar-polyethylene. Radiation caused fragmentation of polymer molecules so that extractable materials were produced in amounts estimated to be possibly as high as 4% by weight of the film. Odoriferous compounds were also released by irradiation. (See also AD-203085.) (auth)

**14138** AD-206531

New York. State Univ. Veterinary Coll., Ithaca.  
 Lab. of Radiation Biology.

**DEPOSITION AND REMOVAL OF RADIOISOTOPES FROM THE BODY.** Quarterly Progress Report [for] July 1, 1958-September 30, 1958. C. L. Comar, R. H. Wasserman, and F. W. Lengemann. Sept. 30, 1958. 14p. Contract DA-49-007-MD-897.

The mechanism has been studied by means of which lactose increases strontium absorption. This increased absorption cannot be accounted for entirely by the longer emptying time of the stomach in the presence of lactose or the fermentation of lactose to acid products. It was found that the lactose effect was not related to vitamin D or insulin action. Also, various metabolic inhibitors had no effect on the action of lactose. Potassium rhodizonate (which has been claimed to selectively remove strontium from the body as compared to calcium) was found to have no effect on skeletal retention of  $\text{Ca}^{45}$  and  $\text{Sr}^{85}$  when included in the diet. In the young growing rat, an increase of dietary calcium level produced essentially a proportional decrease in retention of dietary radioactive strontium. In mature rats an increase of dietary calcium alone was not effective; however, an increase of both dietary calcium and phosphorus was somewhat effective in reducing  $\text{Sr}^{85}$  retention. The studies indicated that increases in dietary calcium are preferred to increases in dietary strontium for the purpose of reducing the retention of ingested radiostrontium. (auth)

**14139** AD-210708

New York. State Univ. Veterinary Coll., Ithaca. Lab. of Radiation Biology.

**DEPOSITION AND REMOVAL OF RADIOISOTOPES**

**FROM THE BODY.** Quarterly Progress Report [for] October 1, 1958-December 31, 1958. C. L. Comar, R. H. Wasserman, and F. W. Lengemann. Dec. 31, 1958. 12p. Contract DA-49-007-MD-897.

Work has continued on the reasons for the ability of certain sugars and sugar derivatives to increase gastrointestinal absorption of strontium and calcium. This property appears to be related, at least in part, to increased fluid retention in the gastrointestinal tract. Since versene has been found to suppress the action of lactose it is concluded that the sugars act only on ionized or readily ionizable strontium or calcium. The action of lactose is observed even when it is administered 2 hours after the alkaline earth. Chemical studies have indicated that the carbohydrates most probably do not act by modification of the solubility of alkaline earth salts. Studies have been started to determine the practicality of reducing retention of acute dosages of radiostrontium by administration of levels of stable strontium high enough to reduce calcification rate as well as provide some measure of isotope dilution. Experiments have been designed and initial studies carried out with rats that may lead to an understanding of the absorptive processes that are operative for calcium and strontium. These are based on development of animals that have specific alkaline earth absorption patterns because of previous nutritional history, and the subsequent testing of these patterns by use of graded levels of carrier. (auth)

**14140** AECU-4163

California. Univ., Davis. School of Veterinary Medicine.

**THE EFFECTS OF SR-90 ADMINISTERED DURING THE GROWTH PERIOD OF THE DOG.** 1958 Annual Progress Report. 45p. Project No. 6. Contract AT-11-1-GEN-10. \$7.80(ph), \$3.30(mf) OTS.

Preparations were made for a study on the effects of strontium-90 contaminated food on the growth of dogs. The experiment will use 1,000 dogs. Experimental dogs will be restrained in cages during the period of isotope administration and in outside pens for life-span studies. Isotope administration will begin in utero and continue until the dogs are 18 months of age. Results of pilot experiments are presented, the design and construction of the experimental facilities are discussed, and experimental procedures are outlined. (C.H.)

**14141** AECU-4178

New York Univ.-Bellevue Medical Center, New York.  
 Inst. of Industrial Medicine.

**TISSUE REACTIONS TO INTRAPULMONARY RADIATION.** Progress Report to November 1, 1957. Marvin Kuschner, Norton Nelson, Sidney Laskin, John Harley, and Bernard Altschuler. Includes Appendix: DOSIMETRY FROM A  $\text{Ru}^{106}$ -COATED PLATINUM PELLETT. Bernard Altschuler. 37p. Contract AT(30-1)-1925. \$6.30(ph), \$3.30(mf) OTS.

Squamous metaplasia of bronchial epithelium and squamous cell carcinomas of bronchial origin have been produced in the lungs of rats exposed to beta radiation from the ruthenium-rhodium system ( $\text{Ru}^{106}\text{-Rh}^{106}$ ). By means of an intrabronchial pellet implant technique, it was possible to expose animals to a range of doses from well defined sources. Graded doses were secured by plating upon pellets of amounts of  $\text{Ru}^{106}$  ranging from  $7 \times 10^{-3}$  to 14 microcuries. Cancers have appeared as early as eight months at doses to the epithelial tissue estimated at  $2 \times 10^5$  rads. Advanced squamous metaplasia was seen as early as 6 days (70 rads). The inci-



dence data relating to metaplasia are suggestive of a dose response relationship. The pellet technique appears promising for the study of the serial stages in the morphogenesis of radiation induced cancer of the lungs. (auth)

**14142** AMNL-224

Army Medical Nutrition Lab., Denver.

SHORT-TERM HUMAN FEEDING STUDIES OF FOODS STERILIZED BY GAMMA RADIATION AND STORED AT ROOM TEMPERATURE. Edwin L. Bierman, Irvin C. Plough, Jacqueline H. Sellars, Virginia E. McGary, Elizabeth M. Nevels, Eugene M. Baker, Richard S. Harding, Jean Richmond, and Betty O. Bowman. July 1, 1958. 28p. (PB-151152). \$0.75(OTS).

Short-term human feeding studies were planned to determine the nutrient content and to test for the appearance of decomposition products in foods which have been treated with ionizing radiations and stored 3 months at room temperature and to test the acceptability and possible acute toxicity of the foods in human subjects. Eighteen foods, including 5 meats and meat products, 6 vegetables, 6 fruits and fruit products, and one cereal, were frozen, irradiated at the following levels (rep), and subsequently stored 3 months at room temperature: potatoes, 10,000; flour, 75,000 to 80,000; oranges, 150,000; all others, 2,500,000 to 4,000,000. The control foods were similarly frozen, but were stored in the deep-freeze. Three alternate diets were prepared in which the irradiated (or the identical control) foods constituted 80% of the total calories. They were fed to -- volunteer human subjects during 15 days of control diets and 15 days of irradiated food diets. The foods contained no soluble substances toxic to mice. No clinical abnormalities were noted in the human subjects. Irradiation decreased the thiamine and ascorbic acid content and increased the browning reaction derivatives, fat soluble carbonyl compounds, and thiobarbituric acid reactants. Except for string beans and orange juice, no significant differences in acceptability were noted between the irradiated and control foods. (auth)

**14143** ANL-5916

Argonne National Lab., Lemont, Ill.

BIOLOGICAL AND MEDICAL RESEARCH DIVISION SEMI-ANNUAL REPORT [FOR] JANUARY THROUGH JUNE 1958. Sept. 1958. 152p. Contract W-31-109-eng-38. \$3.00(OTS).

The hemolysis system in gamma-irradiated rabbits was used in a study of the qualitative as well as the quantitative characteristics of the radiosensitivity of antibody production. Applications of IBM equipment in the analysis of biological data are discussed. Cytological features are described which were observed in buckwheat grown in carbon dioxide containing carbon-14. Electron microscopic observations are described which were made on the ovotestis of a pulmonate snail and on ciliate nuclear phenomena in *Tetrahymena*. Results are reported from a study of the comparative carcinogenicity of radium-226, strontium-90, and calcium-45 in mice. Results of tracer studies on metabolism in cultures of *Escherichia coli* indicate that in growing cultures of bacteria, intracellular protein degradation and nucleic acid degradation do not occur and that under normal conditions cell death rarely occurs. Data on the heterologous growth of mouse ascites tumor in the rat are summarized. Observations on radiation injuries in chick embryos following exposure to cobalt-60 gamma radiation suggest two distinct modes

of radiation injury. Findings are discussed. Progress is reported in the following studies: investigations of the heat-stable factor necessary for inhibition of catalase; the enzymatic decomposition of S-adenosylmethionine and methylthioadenosine; protein synthesis in the pancreas; the response of various mouse strains and hybrids to daily dosages of cobalt-60 gamma radiation; the effects of heavy water on kidneys and liver of rats; the effect of x radiation on the intracellular distribution of cytochrome oxidase in the rat thymus; the dependence of acute and subacute radiosensitivity on age in mice; the rate of recovery from radiation injury; the effect of fractionation of dose on biological effects of fission neutrons; the relative biological effectiveness of fission neutrons and cobalt-60 gamma radiation evaluated by 15 different biological tests on a widely varying group of plants and animals; the life-shortening effect of whole-body exposure to ionizing radiation in mice; the effectiveness of new chelating agents in the treatment of plutonium poisoning; the effects of radio-toxic levels of gamma-emitting isotopes on distribution and retention patterns established by tracer methods; the effects of ultraviolet radiation on amoebae; tracer studies on the life cycle of leukocytes; the dynamics of the release of histamine from tissue mast cells; the effect of repeated paracentesis on the growth of Ehrlich ascites tumor cells in mice; the effects of deuterium oxide in drinking water on pregnancy and on viability of newborn mice; the radioactivity of grass grown on thorium-bearing sand; and tracer studies on the metabolism of proteins, fatty acids, and cholesterol. (For preceding period see ANL-5841.) (C.H.)

**14144** NM-006-012.04.103

Naval Medical Research Inst., Bethesda, Md.

AN ANALYSIS OF THE EFFECTS OF TOTAL BODY X-IRRADIATION OF THE BODY WEIGHT OF WHITE SWISS MICE. III. BODY WEIGHT CHANGES OF FEMALE MICE AS A BIOLOGICAL DOSIMETER. William H. Chapman and Edward A. Jerome. July 2, 1956. 9p. (AD-154457).

A dosimetric technique, using percent weight change as a biological indicator of x radiation dose, has been tested on a group of 640 female mice. The technique was originally developed on a group of 1007 male mice, so that the present analysis constitutes an independent repeat verification of the first study. Not only do these two independent studies agree in indicating that the dosage of x radiation can be satisfactorily estimated from percent body-weight changes, but the empirical constants of the estimating equations were found to be remarkably similar in the two cases. (auth)

**14145** NM-52-01-00.05.01

Naval Medical Research Inst., Bethesda, Md.

A STUDY OF SOME EFFECTS OF GAMMA RADIATION ON THE ADULTS AND EGGS OF *Aedes aegypti*. Levon A. Terzian and Nathan Stahler. July 10, 1958. 13p. (AD-205978).

The studies reported were undertaken to evaluate some of the biological effects produced by gamma radiation in the mosquito, *Aedes aegypti*. It has been shown that egg production was reduced either by mating normal females with males which had been exposed 8 or 15 days previously to dosages of about 30,000 r, or by irradiating females with dosages in excess of 2,500 r (with no oviposition at 10,000 r). Reduction in egg hatch was proportionate to dosages in excess of 2,500 r, applied to either adult males or females, with no eggs



hatching at 10,000 r. Egg hatch was less if females had been inseminated prior to exposure than if insemination had occurred after irradiation. It required dosages of 10,000 r to inhibit egg production in females exposed 4 hours after a blood meal, and 100,000 r to cause the same effect in mosquitoes which had had a blood meal 42 hours previously. Viable, fertile F-1 progeny could be produced only from females which had been irradiated at dosages less than 5,000 r. Eggs were found to be most sensitive to irradiation during the prehatching period, the LD<sub>50</sub> varying from 800 r to 7,500 r, and most resistant when 3 to 5 days old, the LD<sub>50</sub> ranging from 30,000 r to 75,000 r. Progeny could be reared only from eggs which had been irradiated at dosages less than 2,500 r. (auth)

**14146** NP-7498

Illinois, Univ., Chicago, Coll. of Medicine.  
POSSIBLE CARCINOGENICITY OF IRRADIATED FOODS. Progress Report [for] October 15, 1958 to March 15, 1959. Harry Monsen. 4p. Contract DA49-007-MD-794.

Irradiated pork loin, chicken, evaporated milk, blanched carrots, ( $6 \times 10^6$  rep), and white potatoes ( $1$  or  $2 \times 10^4$  rep) were fed to strong A and Cb mice. No data on carcinogenicity are presented, but nutritional adequacy and acceptability are discussed. (T.R.H.)

**14147** NP-7499

Syracuse Univ., N. Y. Biological and Food Research Center.

LONG-TERM FEEDING OF IRRADIATED CHICKEN STEW AND COLESLAW TO RATS. Progress Report No. 4 [for] September 15, 1958 to March 15, 1959. A. W. Phillips. 18p. Contract DA-49-007-MD-783.

The growth response of 2nd generation female rats was observed to be different among the three levels of irradiated coleslaw and between replicates; however, no significant differences were observed in the growth response of males fed irradiated chicken stew and coleslaw. Weekly food consumption and weekly feed efficiencies covering the growth period showed essentially little difference between the control and irradiated groups when these values were calculated for the entire growth period. Except for a significantly lower weaning weight of young from the irradiated groups of the 2nd breeding only, no real differences were apparent in reproduction and lactation of 2nd generation animals from either the control group or irradiated groups. Hematologic examinations of parent generation rats have shown so far essentially the same pattern as regard blood values for the control and irradiated groups. After 80 experimental weeks there appeared to be no marked differences in longevity of parent generation rats fed either irradiated or non-irradiated chicken stew and coleslaw. (auth)

**14148** NP-7603

Syracuse Univ., N. Y. Biological and Food Research Center.

LONG-TERM FEEDING OF IRRADIATED SHRIMP, PEELED AND WHOLE ORANGES. Progress Report No. 4 [for] November 18, 1958-March 15, 1959. A. W. Phillips. 28p. Contract DA-49-007-MD-791.

The feeding of shrimp and oranges to 2nd generation rats has shown that irradiation of these foods had no adverse effect on either their growth or reproduction. Gross pathological findings as regards these animals were essentially negative in practically all cases except for the incidence of murine pneumonitis and otitis

media. Blood values of parent generation rats were normal for both control and irradiated groups. The data as regards the long term feeding study of irradiated whole oranges have shown that irradiation has had no adverse affect on either the growth and reproduction of 2nd generation rats or the blood values and longevity of parent generation rats. (auth)

**14149** OEG-78

Office of the Chief of Naval Operations. Operations Evaluation Group, Washington, D. C.

THE EFFECTS OF RADIATION ON POPULATIONS. July 17, 1958. 85p.

The possible effects on present and future generations of the exposure of human populations to penetrating radiations are discussed. This subject is widely associated with the effects of nuclear weapons and has been the subject of much public discussion and opinion, not all of it accurate. The well-established scientific evidence is summarized because a critical appreciation of the subject by Naval officers is necessary to effect sound planning. Although the more severe local effects of a nuclear detonation, such as radiation death or radiation sickness are comparatively well known, the use of nuclear weapons may also result in widespread and prolonged exposure of whole populations to radiation. For example, the detonation of a nuclear weapon in the northern hemisphere will raise the radiation level throughout the hemisphere with effects on the health and survival of both living children and those to be born for generations to come. These long-range effects will not be confined to the enemy population; they will be felt by our own and that of our allies as well. The scientific basis of such global effects is surveyed. The long-range effects of low levels of radiation from external sources such as those resulting from bomb fall-out are discussed. These long-range effects result from such low radiation levels, compared to those producing local effects, that they are measurable principally on growing children and on future generations. The effects of somewhat higher radiation levels, such as those produced near a bomb detonation, or globally from a heavy and protracted nuclear exchange, as well as the effects of the ingestion of strontium 90 deposited in fall-out are also discussed. The effects of very high radiation levels are not treated because they are considered to be widely known. It is shown that even very low levels of radiation can cause discrete hereditary units called genes to change, or mutate, and that eventually such mutated units will cause a death in a future generation. These genetic effects are unimportant if all those exposed to radiation are killed as a result of the exposure. But if those exposed survive, the less-than-lethal exposure may result in the serious impairment or death of some of their descendants for many generations. Even though under mild conditions of exposure the effect on the death rate in any one generation may be small, the cumulative number of deaths in all affected generations may be very large. An example cited shows that so far the very small increase in background radiation due to fall-out from present weapons testing may, very roughly, result in an ultimate total of 60,000 embryonic, infant, and childhood deaths in the United States in future generations. (auth)

**14150** PB-131948

Oregon. Agricultural Experiment Station, Corvallis.  
A CORRELATION IN RADIATION STERILIZED FOODS OF THE CHEMICAL CHANGES ASSOCIATED WITH THE CHARACTERISTIC FLAVOR DEVELOPMENT.

Report No. 9 (Final) [for] April 22, 1955-June 30, 1956. H. W. Schultz. 14p. Project No. 7-84-01-002. Contract DA-19-129-QM-407. \$0.50(OTS).

Irradiated and control meats were analyzed for TBA, peroxide, and fluorescent values. In some meats the lowering of flavor score can be correlated with chemical tests. The irradiation of meat samples intermittently or at elevated temperatures lowers the TBA color produced and the peroxide value. A modification of the TBA reaction with meats, using cellulose powder to eliminate yellow coloration, produces more reproducible results. The typical TBA color has two spectrophotometric peaks, but separates into three bands on column chromatography. The spectrophotometric peaks and the column separation of an irradiated meat sample closely resemble that obtained with the 2 carbon dialdehyde glyoxal. Irradiated pure or water dilute glycerol shows reactions that are very similar to irradiated meat. The TBA reaction, the fluorescence, the carbonyl content and the level of glyoxal all increase with increasing irradiation, while pH decreases with increasing irradiation. The addition of amino acids to irradiated glycerol gives sharp increases in fluorescence. (auth)

#### 14151 PB-131967

Ohio State Univ. Research Foundation, Columbus. CHEMICAL AND ORGANOLEPTIC CHANGES IN CARBOHYDRATES AND PROTEINS PRODUCED BY RADIATION STERILIZATION. Report No. 6 (Final) [for] October 20, 1955 to April 19, 1957. M. L. Wolfson. 82p. Project No. 7-84-01-002. Contract DA19-129-QM-515. \$2.25(OTS).

Chromatographic and other isolative techniques were used to study the effects of ionizing radiations on carbohydrates. D-mannitol was converted to mannose and arabinose. D-glucitol yielded glucose, arabinose, and xylose. The  $\alpha$ -linkage in maltose and cellobiose is more readily attacked than the  $\beta$ , but neither glycosidic bond is attacked to any large extent. Maltose may be hydrolyzed to glucose by radiation. Gamma radiation on 2% aqueous raffinose produced melibiose, sucrose, glucose, fructose, and galactose. Hydrolysis of raffinose is suggested, inulin, at the radiosterilization dose is not degraded to fructose. Cathode rays on starches produced dextrans. Reinvestigation of ionizing radiation effects on sucrose is reported. Sucrose is hydrolyzed much more by cathode rays than by soft x rays. Keto sugars were found in the radiolysis products of D-fructose. Radiation effects studies on ethylene glycol indicated changes, and the data are given but no interpretation is made. (See also PB-121310.) (T.R.H.)

#### 14152 JPRS(NY)-731

RADIOBIOLOGY IN THE U.S.S.R. UTILIZATION OF RADIATION AND RADIOISOTOPES IN BIOLOGY AND MEDICINE IN THE U.S.S.R. Translation of Articles from selected Soviet periodicals. Sept. 23, 1958. 31p. (PB-141466-T). \$1.00(OTS).

Summaries are presented of results of recent studies in the fields of biology and medicine in which radiation and radioisotopes were used. Information is included from studies on the synthesis of blood plasma substitutes, blood preservation, blood transfusions, blood flow measurements, the present state of the chemotherapy of cancer, the application of radioactive preparations in the treatment of neoplasms, studies of cell composition, the beneficial effects of immune serum in the treatment of severe burns, the treatment of radiation injury, therapeutic applications of radia-

tion, and applications of radioisotopes in studies on metabolism. A list is included of new books in related fields. (C.H.)

#### 14153

PROTECTIVE EFFECT OF ARTIFICIALLY INDUCED HIBERNATION AGAINST LETHAL DOSES OF WHOLE BODY X-IRRADIATION IN CF<sub>1</sub> MALE MICE. Sondra M. Kuskin, S. C. Wang, and Roberts Rugh (Columbia Univ., New York). *Am. J. Physiol.* 196, 1211-13(1959) June.

Hypothermia induced by the use of neuroplegic drugs such as Hydergine, chlorpromazine, or promethazine, followed by refrigeration, does not significantly enhance the protective action afforded by refrigeration alone against the lethal dose of whole body x-irradiation in CF<sub>1</sub> male mice. The neuroplegic drugs, without refrigeration, provide a slight degree of protection, probably due to the slight reduction in the body temperature. It appears that the action of hypothermia as a protective mechanism depends not on depression of metabolism alone, but on a general depression of bodily processes. Urethane, in conjunction with refrigeration, appears to augment the lethal effect of x-irradiation in the CF<sub>1</sub> strain of male mice. (auth)

#### 14154

STIMULATION OF CHOLESTEROL BIOSYNTHESIS FROM ACETATE IN RAT LIVER AND ADRENALS BY WHOLE BODY X-IRRADIATION. R. Gordon Gould, Virginia L. Bell, and Edith H. Lilly (Los Alamos Scientific Lab., N. Mex.). *Am. J. Physiol.* 196, 1231-7(1959) June.

Whole-body x irradiation resulted in an increased cholesterol biosynthesis in rat liver and adrenal glands, as measured by the rate of incorporation of either acetate-1-C<sup>14</sup> or H<sup>3</sup>OH in intact animals. The effect was significant 24 hours postirradiation but was much larger at 48 hours, and was proportional to dosage over the range 300 to 2400 r. In liver the increase in rate was about 100%/100 r. Intestine showed no effect and carcass only a slight increase. Mice showed a small increase in hepatic cholesterol biosynthesis but rabbits and guinea pigs no significant change. Rats injected with both acetate-1-C<sup>14</sup> and H<sup>3</sup>OH gave reasonably constant ratios of C<sup>14</sup> and H<sup>3</sup> in liver and carcass cholesterol in control and irradiated animals, supporting the hypothesis that the use of acetate-1-C<sup>14</sup> in whole animals under standard conditions is a reliable measure of cholesterol biosynthetic rate. The proximate cause of the increased rate of cholesterol synthesis is postulated to be the decreased concentration; in liver a decrease of 0.12 mg/gm was correlated with a doubling of the synthetic rate. (auth)

#### 14155

HORMONAL FACTORS INFLUENCING POSTIRRADIATION CREATINURIA AND POLYURIA IN THE RAT. G. M. Drise and C. M. Williams (Univ. of Texas, Austin and U. S. Air Force, Balcones Research Center, Austin, Tex.). *Am. J. Physiol.* 196, 1352-5(1959) June.

Normal albino rats exposed to 1500 r of whole-body Co<sup>60</sup> gamma radiation were found to have a significant increase in urinary creatine excretion for the first 3 postirradiation days. Adrenalectomized rats, irradiated at 8 days postoperatively, did not show a creatinuria significantly greater than nonirradiated controls. Thyroparathyroidectomized rats, irradiated at 8 days postoperatively, did not have a significant increase in urinary creatine excretion over that of nonirradiated fasted controls. There were no significant increases in poly-



uria or polydipsia on the 1st postirradiation day in either the adrenalectomized or thyroparathyroidectomized rats. The intramuscular injection of 500  $\mu$  of the antidiuretic hormone vasopressin (Pitressin tannate) in oil inhibited postirradiation polydipsia and polyuria in normal rats but significantly increased the urinary excretion of creatine over that of irradiated noninjected controls. (auth)

#### 14156

ENZYMIC STUDIES OF X-IRRADIATED CORNEA AND LENS WITH SPECIAL REFERENCE TO GLUTATHIONE REDUCTASE. R. E. Kuhlman and R. A. Resnik (National Inst. of Neurological Diseases and Blindness and Dept. of Health, Education and Welfare, Bethesda, Md.). Biochem. J. 72, 261-5(1959) June.

Whole lens and cornea of rabbits exposed to x irradiation were assayed 1, 4, and 14 days afterward for hexokinase and glutathione reductase activity. Corneal epithelium was assayed for hexokinase, glutathione reductase and isocitric dehydrogenase 4 and 14 days after x irradiation. In spite of morphological changes under these conditions of irradiation, there was no alteration in enzyme content. A sensitive method for the assay of glutathione reductase in tissue is presented. Its activity in tissues of the rat, rabbit, and calf is compared. (auth)

#### 14157

CERTAIN SPECIFIC FEATURES OF THE HIGHER NERVOUS ACTIVITY OF FULLY GROWN ANIMALS IRRADIATED ANTENATALLY WITH IONIZING RADIATION. I. THE INFLUENCE OF IONIZING RADIATION ON THE OFFSPRING. I. A. Piontkovskii (Inst. of Higher Nervous Behavior, Academy of Sciences, U.S.S.R., Moscow). Bull. Exptl. Biol. Med. (USSR) (English Translation) 46, 1101-4(1958) Sept.

Irradiation of pregnant female animals and women with ionizing radiation may cause the appearance of a variety of congenital deformities in the offspring and may interfere with their postnatal development. L. Hicks points out the particular sensitivity of the nervous system of the embryo to ionizing radiation. Thus irradiation of rats on the 9th, 11th, 12th, and 13th days of prenatal development may cause, in addition to somatic deformities, anencephaly (on the 9th day), hydrocephaly (on the 11th day), microcephaly (on the 12th-13th day), failure of development of the subcortical structures, the corpora callosa and so on. The influence of ionizing radiation on the nervous system during antenatal irradiation has been studied mainly morphologically. There are no indications in the literature of the state of the higher nervous activity of fully grown animals exposed at various periods of their antenatal development to the action of ionizing radiation. The effect of ionizing radiation, applied in various doses and at different stages of embryonic development, on the state of the higher nervous activity of animals was studied. (auth)

#### 14158

CHANGES IN THE ADRENALIN CONTENT OF THE BLOOD AND OF THE AQUEOUS HUMOR OF THE EYE OF THE RABBIT AFTER IRRADIATION. A. S. Maslova. Bull. Exptl. Biol. Med. (USSR) (English Translation) 46, 1105-8(1958) Sept.

The reaction of the endocrine glands to the action of ionizing radiation plays an essential role in the development of radiation sickness. Several features, beginning with changes in the blood picture and ending in trophic

disturbances of complex origin, are explained by the action of ionizing radiation on the glands of internal secretion. Accordingly it is profitable to study these endocrine mechanisms. According to the ideas of modern radiobiology, the participation of the glands of internal secretion in these reactions is determined by nervous influences on the glands and also by interaction between them. Great importance in these interactions is attached to the reaction of the medullary substance of the adrenals. Some time ago the opinion was expressed that under the influence of ionizing radiation the secretion of adrenalin is intensified. On the other hand great importance must be attached to the increased adrenalin content of the blood as a factor stimulating the reticular substance and exerting an action on all divisions of the central nervous system, including the vegetative centers of the brain stem. It is for this reason that in studying the reaction of the endocrine glands on the action of ionizing radiation, investigation of the adrenalin content of the blood is of particular interest. (auth)

#### 14159

MEASUREMENTS WITH A WHOLE BODY COUNTER. K. G. McNeill and R. M. Green (Univ. of Toronto). Can. J. Phys. 37, 683-9(1959) June.

An account is given of work on the measurement of the gamma radioactivity of humans. A steel room has been constructed, in which this gamma activity may be measured to a statistical accuracy of a few per cent in 30 minutes using a 5-in. NaI crystal as detector. The average potassium content of thirty 19-year-old males living in Ontario has been found to be 0.21% of body weight, and the average Cs/K ratio 51  $\mu$ mc/g K. (auth)

#### 14160

KILLING EFFECT OF RAT BONE MARROW IN SUBLETHALLY IRRADIATED LAF<sub>1</sub> MICE. N. Gengozian, W. J. Peterson, and T. Makinodan (Oak Ridge National Lab., Tenn.). Cancer Research 19, 534-7(1959) June.

Injection of a high rat bone marrow (RBM) dose into LAF<sub>1</sub> mice that had received 640 r (LD<sub>0</sub>) resulted in 100 per cent mortality 19 days after treatment. Injection of a smaller amount of RBM cells into similarly irradiated mice gave a mortality comparable to that obtained with x rays only. Treatment of lethally irradiated mice with the two different bone marrow doses showed a greater 30-day survival among those receiving the higher dose treatment. The data are discussed in terms of our hypothesis, which states that an *in vivo* antigen-antibody reaction may occur in irradiated mice treated with foreign bone marrow, depending on the amount and type of bone marrow and the x-ray dose. (auth)

#### 14161

STUDIES ON THE PATHOGENESIS OF NEOPLASMS BY IONIZING RADIATION. I. PITUITARY TUMORS. Jacob Furth, Nechama Haran-Ghera, Howard J. Curtis, and Rita F. Buffett (New England Deaconess Hospital, Boston and Brookhaven National Lab., Upton, N. Y.). Cancer Research 19, 550-6(1959) June.

Pituitary tumor induction by ionizing radiation appears to be a scopal (direct effect). Fission neutrons appeared to have a greater relative biological equivalent in inducing them than x rays. Gonadectomy prior to irradiation prevented or inhibited pituitary tumor development. The radiation-induced pituitary tumors observed were predominantly adrenotropic and mammatropic, with the exception of the head-neck irradiation groups,

in which thyrotropic tumors were frequent. The spontaneous pituitary tumors were predominantly mammothropic. (auth)

#### 14162

THE EFFECT OF SELF- AND EXTERNAL RADIATIONS ON  $I^{131}$ -LABELLED L-THYROXINE AND 3,5,3'-TRIODO-L-THYRONINE IN SOLUTION. Jamshed R. Tata (National Inst. for Medical Research, London). *Clin. Chim. Acta* 4, 427-37(1959) May.

Chemical changes produced in dilute solutions of  $I^{131}$ -labeled L-thyroxine and 3,5,3'-triiodo-L-thyronine by the action of self- and external radiations (high energy x and  $\gamma$  radiation) have been studied quantitatively. The same major products of radiochemical decomposition, Compounds "1" and "2", were obtained from self-radiation in labeled thyroxine and triiodothyronine of high specific activity and from externally irradiated samples of low specific activity. By a combination of chromatographic, electrophoretic and spot-test analyses, Compound "1" has been tentatively identified as 3,5,3',5'-tetraiodothyrolactic acid, with a strong suggestion for the formation of a similar derivative of triiodothyronine. The kinetics of radiochemical change induced by self-radiation of the two iodothyronines have been studied over a period of storage of 40 days. Once formed, the lactic acid analogues of the hormones are rapidly deiodinated. The radiochemical reaction is inhibited by storage in the dried or frozen state or by the addition of cysteine, glycine and human serum albumin. The possible mechanism of the radiation-induced changes and their implications in biological work are discussed. (auth)

#### 14163

EFFECTS OF X RAYS ON THE DEVELOPMENT OF CROWN-GALL TISSUES OF CULTIVATED SCORZONERA IN VITRO. Robert Jonard. *Compt. rend.* 248, 2664-6(1959) May 4. (In French)

X rays cause an inhibition of the growth of crown gall tissues of *Scorzonera* cultivated *in vitro*. This inhibition is permanent and persists during further transplanting of the cultures. It does not appear to be removed by an exogenous application of indole acetic acid. (tr-auth)

#### 14164

QUALITATIVE STUDY OF THE DIGESTIVE ABSORPTION OF STRONTIUM IN THE RAT. Georges Michon and Marie-Joséphe Guilloux (Centre d'Etudes Nucléaires, Saclay, France). *Compt. rend. soc. biol.* 153, 69-72(1959). (In French)

The digestive absorption of Sr in rats was studied by administering orally or by direct injection into various parts of the digestive tract a carrier-free solution of  $Sr^{90}Cl_2$ . The total activity administered was 50  $\mu c$  in a volume of 0.25  $cm^3$ . The solution contained an equilibrium quantity of  $Y^{90}$ . The activity of the blood was measured during a period of time after the administration. The difference in the activity of the blood from  $Sr^{90}$  and  $Y^{90}$  after oral administration is graphed. The solution was also injected directly in the pylorum, duodenum, and cecum. The radioactivity in the blood after injection in the pylorum appears only after 1½ hr. In the other cases it is apparent in 1 to 2 minutes. (J.S.R.)

#### 14165

ACTION OF CYSTEAMINE AND CYSTAMINE ON THE REDUCTION OF THE AVERAGE LIFE OF THE MOUSE AFTER TWO SUCCESSIVE DOSES OF X RADI-

ATION. D. J. Mewissen (Université, Liège and Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). *Compt. rend. soc. biol.* 153, 183-7(1959). (In French)

The effects of cysteamine and cystamine on the x-ray-induced life span reduction in mice were investigated. The mice received 300, 406, 550, or 742 r administered in two separate doses five days apart. The protected animals received immediately before each radiation an injection of either cysteamine or cystamine. The results led to the conclusion that the radio protectors do not appear to decrease the extent of the delayed radiological lesions. They do not modify the acceleration of aging caused by irradiation. (J.S.R.)

#### 14166

THE EFFECT OF COMBINED APPLICATION OF ULTRAVIOLET AND X RAYS UPON THE MUTAGENIC PROCESS IN *STREPTOMYCES AUREOFACIENS* LC-B16. S. Yu. Gol'dat and S. I. Alikhanyan (All-Union Research Inst. of Antibiotics). *Doklady Akad. Nauk S.S.S.R.* 125, 1134-6(1959) Apr. 11. (In Russian)

The effects of ultraviolet rays and x rays on spores were studied, both singly and combined at 1, 2, and 3 hour intervals. The tabulated results show that the lethal effect of the combined irradiation taken at arbitrary succession is considerably below the expected cumulative effect. Experiments indicate that the ultraviolet rays seem to weaken the lethal effects of the succeeding x rays. The effects of the combined irradiation on the *Streptomyces aureofaciens* LC-B16 mutation and the effects related to the time interval between irradiations are tabulated. The mutation frequency in treatments by x rays followed by ultraviolet rays is considerably higher than in the reverse order of irradiation. Preliminary treatment with ultraviolet rays lowered the efficiency of the following x radiation. (R.V.J.)

#### 14167

ON THE MECHANISM OF CELL DESTRUCTION IN HEMATOPOIETIC ORGANS OF MAMMALS, TAKING PLACE UNDER THE INFLUENCE OF IONIZING RADIATION. N. F. Barakina (Severt's'ov Inst. of Animal Morphology, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* 125, 1141-3(1959) Apr. 11. (In Russian)

The reactions of spleen and bone marrow outside of the organism irradiated *in vivo* and *in vitro*, the ability of *in vitro* irradiated bone marrow cells to induce hematopoietic activities in irradiated animals, the development of destructive processes in *in vivo* irradiated spleen in relation to its functional condition, and the behavior of *in vivo* irradiated bone marrow cells injected into the spleen of non-irradiated mice were studied. (R.V.J.)

#### 14168

RADIATION GENETICS OF SESAME. PART III. MORPHOLOGICAL CHANGES AND MUTANTS INDUCED BY IONIZING RADIATIONS. Teisaku Kobayashi (Toyama Univ., Japan). *Idengaku Zasshi* 33, 239-61 (1958) Aug.

Morphological changes and the characteristics of mutants induced by radiation in sesame plants are described. (C.H.)

#### 14169

IMPAIRMENT OF FERTILITY BY WHOLE-BODY IRRADIATION OF FEMALE MICE. R. H. Mole (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Intern. J. Radiation Biol.* 1, 107-14(1959) Apr.



A proper appreciation of ovarian damage by radiation is possible only if enough time is given for the damage to develop. Simple fertility is a less adequate measure of damage than reproductive capacity, the total number of young produced in the reproductive life-span. In C57BL mice this is halved by a single dose of 25 r of x rays and by about 80 r of gamma rays given at 2.2 r daily. The high radiosensitivity of the ovary and the variation of somatic ovarian damage with dose-rate need to be taken into account when interpreting experimental results obtained in the female mouse, especially in studies of the effect of dose-rate on the frequency of radiation-induced mutations. It is possible that more attention should be given to somatic ovarian sensitivity when considering radiation hazards. (auth)

#### 14170

SOME EFFECTS OF X-RAYS ON DIVIDING CELLS IN THE TESTIS AND BONE MARROW OF THE MARSUPIAL POTOROUS TRIDACTYLUS. G. B. Sharman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Intern. J. Radiation Biol. **1**, 115-30(1959) Apr.

Six male specimens of the marsupial Potorous tridactylus were irradiated with 50 to 320 r of x rays. Serial biopsies of testis and bone marrow were performed, some before irradiation to provide control material, and others at intervals up to 16 days after. Standard Feulgen squash preparations were made for cytological examination. Additional information was obtained from whole mounts of long tubule segments in which the spatial relationships of the various cell-types were retained. These provided information relating cellular distribution to the phase of the spermatogenic wave. Extensive destruction of spermatogonia was observed, and evidence was obtained that this takes place in two separate periods, one before and the other after the first post-irradiation mitosis. Cells with deficient chromosome sets were not found in mitosis, and the second phase of cell-destruction probably represents their elimination. The bone-marrow cells showed more chromosome breakage and a shorter mitotic cycle than the spermatogonia. (auth)

#### 14171

THE EFFECT OF CYSTEAMINE ON THE SURVIVAL OF SPERMATOGONIA AFTER X-IRRADIATION. Anita M. Mandl (Univ. of Birmingham, Eng.). Intern. J. Radiation Biol. **1**, 131-42(1959) Apr.

The reduction in the number of spermatogonia and resting pre-spermatocytes following exposure of the scrotum of adult rats to 230 to 460 r was partially inhibited by pre-treatment with 30 mg cysteamine. (auth)

#### 14172

IDENTIFICATION AND FOLLOW-UP OF HOMOLOGOUS AND HETEROLOGOUS BONE-MARROW TRANSPLANTS IN RADIATION-CHIMERAS. W. Welling, O. Vos, W. W. H. Weyzen, and D. W. van Bekkum (National Defence Research Council TNO, Rijswijk, Netherlands). Intern. J. Radiation Biol. **1**, 143-52(1959) Apr.

Using differences in the electrophoretic pattern between host and donor hemoglobins, the proliferation of grafted erythropoietic cells has been studied in irradiated mice treated with homologous bone marrow. The results have been compared with observations made after the transplantation of rat bone marrow into irradiated mice. A complete replacement of host erythrocytes by donor-type cells took 60 to 70 days in mice treated with rat bone marrow. In mice treated with

homologous bone marrow, host-type hemoglobin could no longer be identified after about 50 days. In the latter case the complete replacement must have taken somewhat longer, since the method used to identify hemoglobins is not sensitive enough to detect small amounts of one type of hemoglobin in the presence of large amounts of the other. In mice treated with rat bone marrow a considerable number of total and partial reversals occurred after 675 to 700 r. Only a few partial reversals were found after 800 r. Under similar conditions no reversals were observed after homologous bone-marrow transplantation. It is concluded that the recovery of the host's hematopoietic system depends upon the dose of radiation as well as on the antigenic difference between the host and the donor. (auth)

#### 14173

THE EFFECT OF COLLOIDAL  $^{198}\text{Au}$  ON THE BONE MARROW AND ITS REPLACEMENT IN RABBITS. J. M. Garvan, E. P. George, and F. A. Roche (St. Vincent's Hospital, Darlinghurst, N.S.W., Australia); and S. Vince (Royal Alexandra Hospital for Children, Camperdown, N.S.W., Australia). Intern. J. Radiation Biol. **1**, 153-69(1959) Apr.

The replacement of bone marrow in rabbits subjected to high dose-levels of irradiation has been investigated. Since doses large enough to destroy the marrow of rabbits cause fatal damage to other organs, colloidal  $\text{Au}^{198}$  was used as a source of selective irradiation of bone marrow and other hematopoietic tissues, followed by marrow transfusions. It has been found that  $\text{Au}^{198}$  will produce severe hypoplasia, or even complete aplasia, without causing acute radiation damage to other organs. Roughly half the  $\text{Au}^{198}$  is taken up by the marrow and almost all the rest by the liver. Results from two series of rabbits from which the spleen was removed do not suggest that splenectomy has any significant effect on survival. At certain dose-levels, the survival-rate is substantially increased by marrow transfusions. Increased survival-rate and recovery of leukocyte count was found only after double transfusions. Both controls and transfused animals which survived for more than 14 days after  $\text{LD}_{50}$  continued to survive indefinitely. (auth)

#### 14174

THE VIABILITY OF NEAR-NORMAL IRRADIATED CHROMOSOMES. A. J. Bateman (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Intern. J. Radiation Biol. **1**, 170-80(1959) Apr.

After the exclusion of major mutations, both lethals and semi-lethals, the viability in the *Drosophila* male of X-chromosomes irradiated in sperm shows a slight reduction, which is, nevertheless, highly significant. The change in mean viability is accompanied by a barely significant increase in variance. On the other hand, irradiation of eggs, though yielding the expected major mutations, produces few if any minor mutations. These results indicate mutations of very low magnitude and very high frequency. Alternative possibilities are considered. (auth)

#### 14175

RESPONSE OF MEGAKARYOCYTES OF THE 'AUGUST' RAT TO X-IRRADIATION. Shirley M. Simpson (Royal Cancer Hospital, London). Intern. J. Radiation Biol. **1**, 181-8(1959) Apr.

Methods of evaluating the numbers of megakaryocytes of the 'August' rat are described. As a result of these studies, it is concluded that irradiation causes a block



in cell-divisions in the stem-cell preceding the megakaryoblast, and results in a fall in numbers of megakaryocytes, and consequently of platelets. A similar conclusion was reached by Zajicek and Zeuthen (1956). Megakaryocyte numbers are readily reduced by x rays, a dose of 80 r effecting a reduction of 50 per cent within 7 days of irradiation. Studies on partially shielded animals demonstrated a pronounced megakaryocyte hyperplasia in the shielded sites. Recovery in the irradiated areas was found to commence earlier than after whole-body radiation. These results throw some light on the mechanisms by which platelet levels are maintained after partial-body irradiation. (auth)

#### 14176

RADIOPROTECTIVE ACTION OF S-ALKYL-ISO-THIURONIUM SALTS. M. J. Ashwood-Smith and A. D. Smith (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Intern. J. Radiation Biol.* **1**, 196-8 (1959) Apr.

Intraperitoneal injections of S-ethyl-iso-thiuronium bromide and S-propyl-iso-thiuronium bromide were found to afford a degree of protection to mice against lethal doses of x radiation. Results of preliminary studies are reported, and possible reaction mechanisms are discussed. (C.H.)

#### 14177

THE CLINICAL RADIOLOGIST AND THE PROBLEMS OF OF RADIATION HAZARDS. Wendell G. Scott (Washington Univ., St. Louis). *J. Am. Med. Assoc.* **170**, 421-8 (1959) May 23.

The somatic and genetic effects of radiation on man are reviewed. It is pointed out that diagnostic radiology has had a tremendous growth because of the great contributions it has brought to the health and well-being of mankind. Mankind must learn to live safely in the artificial environment that is being created by the atomic industrial revolution. The problem is first to understand and second to minimize the effects that can arise. During the first 30 years of life the gonadal dose should be strictly limited. Beyond the reproductive period the genetic effects of radiation are of no clinical significance. Methods are outlined for minimizing exposure to radiation during radiologic examinations. (C.H.)

#### 14178

LATE EFFECTS OF TOTAL-BODY ROENTGEN IRRADIATION. V. LONGEVITY AND INCIDENCE OF NEPHROSCLEROSIS AS INFLUENCED BY PARTIAL-BODY SHIELDING. Baldwin G. Lamson, Marta S. Billings, and Leslie R. Bennett (Univ. of California, Los Angeles). *J. Natl. Cancer Inst.* **22**, 1059-75 (1959) June.

After receiving 1000 r, hypoxic, total- or partial-body irradiation, 242 female Wistar rats were observed throughout their life span. Hypoxic irradiation with superimposed anesthesia resulted in 67 percent, 30-day mortality. Selection of the colony by acute post-irradiation deaths did not influence the magnitude of late radiation sequelae as measured by life-shortening. Growth retardation during the 2d post-irradiation year was well correlated with life-shortening. Life-shortening was observed after partial-body irradiation, to an extent approximately proportional to the weight of irradiated tissue. Nephrosclerosis was not observed unless the upper abdomen was included within the radiation field. Other than nephrosclerosis, a similar incidence of disease was observed, at death, in control and partial- or total-body irradiated rats. (auth)

#### 14179

FETAL EXPOSURE TO DIAGNOSTIC X RAYS, AND LEUKEMIA AND OTHER MALIGNANT DISEASES IN CHILDHOOD. Dorothy D. Ford, J. C. S. Paterson, and W. L. Treuting (Tulane Univ., New Orleans). *J. Natl. Cancer Inst.* **22**, 1093-1104 (1959) June.

A survey of the comparative incidence of exposure to antenatal irradiation in utero and of the occurrence of leukemia and other malignant diseases in later childhood is reported. The case material consisted of deaths, before the age of 10 years, from leukemia and other malignant diseases, in Louisiana during the 5-year period 1951 to 1955. The control cases were deaths from other causes matched for age, sex, race, and place of death. Information concerning the incidence of irradiation (diagnostic x rays during the last trimester of pregnancy) was obtained from professional sources, either from the doctor who delivered the mother or from the institution in which the child was born. The incidence of x ray exposure was found to be as follows: leukemia cases, 26.9 percent; malignant disease cases, 28.4 percent; and control cases, 18.3 percent. These findings are in substantial agreement with those of Stewart et al., in England. The findings lend emphasis to the need for minimizing exposure of the fetus to x rays, by careful determination of the indications for antenatal radiography and by attention to the technical procedures. (auth)

#### 14180

CHANGES OF THE ARTERIAL PRESSURE OF IRRADIATED ANIMALS IN ETHER AND HEXANAL NARCOSIS. E. F. Leonova (Piragov, Odessa Medical Inst.). *Med. Radiol.* **4**, No. 2, 3-10 (1959) Feb. (In Russian)

In long-continued ether narcosis instituted to irradiated (400 r) cats experimented upon 1 and 5 days following irradiation, the arterial pressure drops considerably more than in non-irradiated animals. In difference to control animals, in which the over-dosage of ether produces at the beginning the cessation of respiration and then a decrease of the arterial pressure, in the irradiated animals the over-dosage of ether causes a sharp drop of the arterial pressure before the cessation of respiration. A more marked decrease of the blood pressure in the irradiated animals in ether narcosis, as well as its sharp drop in over-dosage of ether, indicates a lower stability of the vasomotor center of the irradiated animals to ether, as compared to control animals. Hexanal narcosis decreases the arterial pressure in the irradiated animals to a lesser degree than ether narcosis. (auth)

#### 14181

PROPHYLAXIS OF RADIATION SICKNESS IN THE INTRAUTERINELY IRRADIATED FETUS. A. P. Kiryushchenkov (Sechenov Moscow Medical Inst.). *Med. Radiol.* **4**, No. 2, 10-15 (1959) Feb. (In Russian)

Pregnant rats were subjected to single total x-ray irradiation of 200 and 300 r on the 9th day of pregnancy. Another group of rats was irradiated on the 15th day by 300 r. Mercaminchlorhydrate was administered to pregnant animals 5 to 15 minutes before the irradiation in the dose of 15 mg (75 mg per kg of body weight). Administration of mercamin before the 300 r irradiation on the 9th day of pregnancy did not protect the embryos from the intrauterine death at the early stages of their development. The prophylactic use of mercamin on the 9th day of pregnancy in irradiation of rats by 200 r resulted in the decreased percentage of the intrauterine



death and in the increased percentage of the offsprings born alive. Administration of mercamin before the irradiation of rats on the 15th day of pregnancy resulted in a considerable decrease of still births, the increased percentage of survival of the offsprings, and the lesser gravity of radiation sickness in the new born rats. Regeneration of the white and red blood in pregnant animals to which mercamin was administered before the irradiation commenced earlier in comparison with the group of rats irradiated without mercamin. Thus, it is possible to protect the fetus irradiated prenatally by mercamin. The protective effect of mercamin is most pronounced after the termination of the process of organogenesis. (auth)

#### 14182

THE EFFECT OF SINGLE PROLONGED ADMINISTRATION OF RADIOSTRONTIUM INTO THE GASTROINTESTINAL TRACT OF A RAT'S ORGANISM. L. N. Budko and V. N. Streltsova. *Med. Radiol.* 4, No. 2, 20-9 (1959) Feb. (In Russian)

The biological effects of  $\text{Sr}^{89}$  and  $\text{Sr}^{90}$  and their mixtures in single and daily (for 100 days) introduction into the gastrointestinal tract in doses exceeding the highest permissible by 1 to 3 times were studied. The specific activity exceeding the maximum permissible by one ( $7.3 \text{ mc } \text{Sr}^{90}$ ,  $30 \text{ mc}^{89}$ ,  $30 \text{ mc } \text{Sr}^{89,90}$ ) do not change the life span of animals. However, they provoke a moderate transient leukopenia. Acute radiation sickness, developing upon single administration of 1500 mc of  $\text{Sr}^{89}$ , 360 mc of  $\text{Sr}^{90}$  into the gastrointestinal tract, runs a course resembling panmyelopenia with an acutely marked hemorrhagic syndrome and affection of the intestine (acute enteritis). In subacute radiation sickness, developing as a result of peroral introduction of strontium isotopes (30 to 300 mc of  $\text{Sr}^{89}$ ,  $\text{Sr}^{89,90}$ , 73 mc of  $\text{Sr}^{90}$ ) the following is characteristic: inhibition of bone marrow hematopoiesis coupled with marked pathological regeneration of reticuloendothelium of stroma, leukopenia, moderate terminal erythropenia, intensive ectopic spleen hematopoiesis, secondary degenerative changes of parenchymatous organs, local changes of the gastrointestinal tract (gingivitis, osteitis, periostitis, of jaws, solitary ulcers in the large intestine). Leukemias, and osteosarcomas develop when strontium is introduced into the organism in quantities exceeding the maximum permissible by the order of two or three. (auth)

#### 14183

THE STATE OF THE GASTROINTESTINAL TRACT IN ACUTE RADIATION SICKNESS INDUCED BY THE INTRODUCTION OF RADIOSTRONTIUM. G. A. Lebedeva. *Med. Radiol.* 4, No. 2, 29-35 (1959) Feb. (In Russian)

The morphological changes of the gastrointestinal tract of dogs in acute radiation sickness induced by intravenous administration of radiostrontium in the dose 0.6 mc/kg body weight were studied. There was seen a gradual increase of changes, which were most pronounced at the end of the 4th week following isotope administration. An increased number of plasmatic cells in the stroma of the mucous membrane, appearance of destructive changes in the cells of intramural nerve plexuses, and swelling of the walls of blood vessels were similar with those, developing in acute radiation sickness induced by x ray or gamma irradiation. Certain features of radiostrontium affection are apparently connected with its physico-chemical properties, the character of distribution in the body, and excretion. (auth)

#### 14184

THE CONTENT OF AMINONITROGEN IN THE ORGANS OF RATS IN RADIATION SICKNESS. T. A. Fedorova. *Med. Radiol.* 4, No. 2, 35-7 (1959) Feb. (In Russian)

An investigation was made of the quantitative content of aminonitrogen in the liver, kidneys, and spleen of white rats in normal conditions and following x-ray irradiation (1,200 r). In the liver and spleen of healthy animals there is an approximately similar content of aminonitrogen, averaging 0.37 mg/g of tissue; in the kidneys it averages 0.45 mg/g of tissue. After irradiation the content of aminonitrogen in the liver, kidneys, and spleen uniformly diminishes. One day after the irradiation the aminonitrogen content in these organs drops by 25%, and in three days by 50% as compared to normal conditions. (auth)

#### 14185

LIPOPROTEINS OF MITOCHONDRIA IN THE LIVER OF RABBITS IN ACUTE RADIATION SICKNESS. V. D. Blakhina. *Med. Radiol.* 4, No. 2, 37-41 (1959) Feb. (In Russian)

The content of lipoproteins in the composition of cellular mitochondria in the liver of rabbits subjected to x-ray doses of 1,000 r was studied. In 1 to 3 days following the irradiation there is seen a certain decrease of the content of the lipoprotein fraction. At the same time there occurs a progressive drop of the lipid content in lipoproteins of cellular mitochondrias in the liver, signifying a partial destruction of this lipoprotein complex. (auth)

#### 14186

CERTAIN PECULIARITIES OF INFLAMMATORY REACTION OF THE PERITONEUM IN ACUTE RADIATION SICKNESS. V. I. Ponomarev. *Med. Radiol.* 4, No. 2, 42-9 (1959) Feb. (In Russian)

The course of experimental aseptic peritonitis induced simultaneously with total irradiation was studied. X-ray irradiation of rabbits (600 to 1000 r) inhibits the inflammatory process of the peritoneum, caused by 1.5% turpentine emulsion introduced into the abdominal cavity. In the course of radiation sickness there is a period during which the inflammatory reaction does not change noticeably. The length of this period is in inverse dependence to the x-ray dosage. The inflammatory process produces an aggravating effect on the course of radiation sickness. It is manifested by an earlier onset of the disease with more pronounced destructive phenomena in the serous layer, and a later appearance of the regenerative process than in uncomplicated radiation sickness. (auth)

#### 14187

THE PATHOLOGICAL ANATOMY OF THE DEATH OF ANIMALS UNDER THE EFFECT OF BETATRON RAY OF 25 Mev. I. V. Toroptsev and N. V. Sokolova (Tomsk Medical Inst.). *Med. Radiol.* 4, No. 2, 50-5 (1959) Feb. (In Russian)

Experiments were performed on 20 adult guinea pigs irradiated by a betatron ray (25 Mev with intensity of 30 to 35 r/min, focal distance 35 cm) with the dose of 25,000 r. Irradiation was carried out at intervals of 15 to 20 minutes after each dose of 7,200 r. The death of the majority of animals took place during the last irradiation, after 21,600 r. The clinical picture of the affection was manifested by early and grave functional changes in the nervous system: short depression is quickly replaced by the increased excitation of the skeletal muscles, and by disturbances of respiration.

The spastic condition of the gastrointestinal tract of certain sphincters and disturbances of hemodynamics develop at an early date. The leading role in the mechanism of death is played by the disturbance of the hemodynamics and, particularly, the anemization of the brain, which evidently causes an early disturbance of the function of the central nervous system. (auth)

**14188**

THE REACTION OF HEMATOPOIETIC ORGANS OF IRRADIATED ANIMALS TO OPERATIVE PROCEDURE. N. I. Shmeleva (Central Research Inst. of Roentgen-Radiology, Ministry of Health, USSR). *Med. Radiol.* **4**, No. 2, 55-9(1959) Feb. (In Russian)

Experiments show that additional trauma (surgical operation) stimulated the regenerative ability of the hematopoietic tissue. In the operated animals there was seen a more rapid increase of the leukocyte count in the peripheral blood, reaching the initial levels towards the 21st day. Similar results were observed in the counting of the absolute quantity of cells in the bone marrow, as well as in analysis of myelograms. A stimulating effect of trauma on the process of hematopoiesis was noted in all series of experiments; however, it was most pronounced when the operation was carried out on the first day following irradiation. (auth)

**14189**

THE CHANGE OF PULMONARY PHAGOCYTES IN RADIATION SICKNESS OF RABBITS. A. E. Ivanov. *Med. Radiol.* **4**, No. 2, 59-62(1959) Feb. (In Russian)

Phagocytosis in the lungs was studied by way of intratracheal introduction of a trypan blue solution with the subsequent counting of cells which have ingested the stain (in prints and histotopographic preparations). Total irradiation of rabbits by filtered x rays (500 r) provokes an inhibition of the activity of pulmonary macrophages. This is expressed by the drop of the number of cells which have ingested the stain, as well as by retarded digestion of trypan blue. Corresponding to the stages of development of acute radiation sickness there is seen a short phase of intensified phagocytosis; gradual reduction of phagocytic activity with subsequent insignificant inhibition at the height of the affection and restoration. (auth)

**14190**

THE USE OF FIBRIN FILMS IN RADIATION INJURIES OF THE SKIN. S. N. Allaverdyan, G. T. Grigoryan, E. Kh. Sarkisyan, and S. A. Mazmanyan (Eolyan Research Inst. of Blood Transfusions, Ministry of Health, Armenian SSR). *Med. Radiol.* **4**, No. 2, 63-6(1959) Feb. (In Russian)

Attempts were made to study the effect of fibrin films alone, as well as in combination with antiseptic preparations, in the treatment of radiation injuries of the skin. Appearing after deep x-ray therapy. 50 patients were treated with fibrin films and favorable results were obtained both in superficial and in deep injuries. The therapeutic effect due to the use of fibrin films was manifested in the alleviation of pains, a more rapid healing of the lesions, prevention of the danger of appearance of secondary infection, and in improvement of nutrition of the affected area. (auth)

**14191**

THE GENERAL IRON CONTENT IN BLOOD PLASMA OF DOGS IN DEVELOPMENT OF ACUTE RADIATION SICKNESS. D. A. Golubentsov. *Med. Radiol.* **4**, No. 2, 78-9(1959) Feb. (In Russian)

The iron levels vary in healthy dogs with a mean

content similar to that of healthy humans. The lethal doses of x rays do not change the iron level in the blood plasma of dogs; hence it can not be used as an indicator for early diagnostic purposes. (R.V.J.)

**14192**

EXPERIMENTAL TUBERCULOSIS IN IONIZING RADIATION. V. A. Solov'eva, T. A. Khudushina, N. M. Makarevich, and M. M. Averbakh. *Med. Radiol.* **4**, No. 2, 79(1959) Feb. (In Russian)

Experiments carried out with 25 tuberculosis-inflicted guinea pigs, exposed to 200 r, showed that in addition to the general depression of organic resistance the radiation injury induces strong pathogenic disturbance of vessel penetrability which induces a progressive development of the tuberculosis. (R.V.J.)

**14193**

PROLONGED STUDIES OF CHANGES OF THE COMPOSITION OF THE PERIPHERAL BLOOD AND BONE MARROW IN ANIMALS FOLLOWING WHOLE-BODY SINGLE X IRRADIATION. T. V. Tkacheva (Central Research Inst. of Roentgenology). *Med. Radiol.* **4**, No. 3, 14-21(1959) Mar. (In Russian)

The changes in the composition of the peripheral blood and the bone marrow in cats following a single whole-body dose of 300 r x radiation were studied over a period of 715 days. The data are tabulated. (J.S.R.)

**14194**

THE ROLE OF SUPRARENALS IN CERTAIN METABOLIC DISTURBANCES IN THE IRRADIATED BODY. B. M. Graevskaya and R. Ya. Keilina (Central Research Inst. of Roentgenology, Ministry of Health, USSR). *Med. Radiol.* **4**, No. 3, 21-5(1959) Mar. (In Russian)

Studies on the changes of carbohydrate and protein metabolism in irradiated animals in dependence on the degree of functional activity of suprarenals are presented. The results of the investigations show inhibition of the hormonal function of the suprarenals under the effect of irradiation. Adrenalectomy considerably weakens the radioinduced intensification of proteolytic processes and the inhibition of phosphorolysis in tissues. (auth)

**14195**

THE EXCRETION OF BROMOSULFALEIN FOLLOWING X IRRADIATION OF THE UPPER PART OF THE BODY IN MICE. M. Skalka (Inst. of Biophysics, Czechoslovakian Academy of Sciences). *Med. Radiol.* **4**, No. 3, 25-6(1959) Mar. (In Russian)

Studies on the excretion of bromosulfalein in mice following x irradiation of the upper part of the body (head, the greater portion of the chest, and forelegs) were made. It was established that in the second week following irradiation with lethal doses (2,000 to 4,000 r) the excretion of bromosulfalein has noticeably slowed down. This points to considerable injury of the liver, established by histological analysis. It is concluded that changes in the liver in the second week after irradiation are indirect, caused by lesions in other parts of the body. (auth)

**14196**

THE AFFECTION OF THE MYOCARDIUM IN RADIATION SICKNESS AND LOCAL X IRRADIATION OF THE CARDIAC REGION. S. I. Teplov, V. S. Sverdlov, and B. F. Korovkin. *Med. Radiol.* **4**, No. 3, 27-33(1959) Mar. (In Russian)

ECG changes in radiation affection of the heart are identical in whole-body irradiation with sublethal and



lethal doses, as well as in local irradiation of the region of the heart. They show a drop in the wave voltage and changes of the terminal part of the ventricular complex—the S—T segment and T wave. The cardiac rhythm tends to accelerate. In radiation sickness these changes are seen in two periods: in the first two days following irradiation and at the peak of radiation sickness on the 7 to 9th day. In local radiation reaction they gradually progress. The histological changes of the myocardium, which may lie at the basis of the above ECG changes, consist in the development of dystrophic changes against the background of hyperemia, reaching the degree of necrosis. At later periods reactive-inflammatory changes develop which appear earlier and are more marked in local irradiation of the heart. At the basis of ECG changes are lesions of biochemical, primarily oxidative, processes in the myocardium. Inhibition of oxidative processes leads to disturbance of the biochemical structure of the heart and to the development of myocardiodystrophy. (auth)

#### 14197

**PECULIARITIES OF THE COURSE OF FROSTBITE IN RADIATION SICKNESS.** O. V. Rudenko (Central Research Inst. of Roentgenology, Ministry of Health, USSR). Med. Radiol. 4, No. 3, 34-9(1959) Mar. (In Russian)

The course of frostbite in the irradiated white rats runs without any marked inflammatory manifestations and is of the dry necrosis type, which has a wider and deeper distribution (third to fourth degree as compared to the first to second degree in the control animals). Radiation sickness coupled with frostbite runs a severer course and is accompanied by high lethality. (auth)

#### 14198

**THE PROTECTION ACTION OF HEROIN ON THE EMBRYOS OF WHITE MICE AFTER WHOLE-BODY IRRADIATION OF THE MOTHER.** F. B. Shapiro. Med. Radiol. 4, No. 3, 39-42(1959) Mar. (In Russian)

The article presents results of experiments on the use of heroin in the protection of white mice embryos from gamma rays ( $\text{Co}^{60}$ ) in whole-body irradiation of the mother. Single total irradiation of females (200 r) was instituted on the 9th and 12th day of pregnancy. Heroin was introduced to gravid females subcutaneously (5 mg) 5 minutes before the irradiation. The protective action of heroin was manifested by: a) reduction of prenatal death of embryos—a decrease of the number of cases of resorption and increase of the quantity of mice in a litter; b) a drop of neonatal mortality (stillbirth and death immediately after birth); c) a diminution of postnatal mortality; and d) normalization of the growth of animals and a decrease of the number of monstrosities. (auth)

#### 14199

**THE EXCRETION OF RADIOACTIVE POTASSIUM IN THE URINE IN MAN IN DEPENDENCE ON THE AGE.** L. A. Kachur, S. E. Manoilo, M. N. Pobedinskii, L. R. Protas, V. I. Feoktistov, and G. A. Sheshina. Med. Radiol. 4, No. 3, 42-3(1959) Mar. (In Russian)

On the basis of radiometric investigation, the excretion of radioactive potassium ( $\text{K}^{40}$ ) with the urine was determined. The quantity of radioactive potassium in the urine increases somewhat towards the age of 25 to 30 years and then markedly decreases. (auth)

#### 14200

**LUMINESCENT MICROSCOPY OF THE PERIPHERAL**

**BLOOD IN X IRRADIATION.** M. Ya. Khodas. Med. Radiol. 4, No. 3, 44-8(1959) Mar. (In Russian)

The possibility of using the method of luminescent microscopy of the peripheral blood for early diagnosis of radiation injury and the evaluation of its severity was investigated. A solution of acridin-orange is used in concentration of 1:10,000, in 30-minute contact of the blood with fluorochrome. The quantity of leukocytes, luminescenting a green light, in healthy rats averaged 96.1%. The effect of single x irradiation (100, 200, 800, and 1,000 r) on the character of luminescence of peripheral blood leukocytes was studied in 4 series of experiments. Irradiation in the above doses produced a qualitatively identical reaction—a reduction of the quantity of cells, stained in green color, with an increase of the percentage of leukocytes, luminescenting a yellow, orange, and red light. With the increase of the irradiation dose the above effect was more stable and marked. In 13 dogs, subjected to single total irradiation of 600 r there was seen a progressive drop of leukocytes with green luminescence. These data give ground to the assumption that luminescent microscopy of the peripheral blood may serve as one of the indices of the severity of radiation affection. (auth)

#### 14201

**THE IMPORTANCE OF LUMINESCENT MICROSCOPY OF THE BONE MARROW IN THE EXPERIMENTAL STUDY OF RADIATION REACTIONS.** I. G. Krasnykh. Med. Radiol. 4, No. 3, 49-52(1959) Mar. (In Russian)

In experiments on white rats the early changes developing in the animal organism as a result of the action of gamma rays in doses of 100 r and lower were studied. The determination of changes, caused by doses of penetrating radiation, were carried out (at 3, 6, and 24 hours after the irradiation) for comparison by two methods: 1) study of the peripheral blood (determination of all leukocyte count and of the leukocytic formula); and 2) luminescent microscopy of the bone marrow. These investigations show that the method of luminescent microscopy of bone marrow has definite advantages over the other method in the assessment of early radiation reactions, developing from the action of low doses of gamma rays. The superiority of this method is especially obvious in combined action (injury plus irradiation), when the wound obscures the radiation reactions of the peripheral blood. The high sensitivity and objectiveness of this method gives wide perspectives of its use in experimental practice. (auth)

#### 14202

**LUMINESCENT MICROSCOPY OF THE BONE MARROW IN THE ACTION OF RADIOMIMETIC SUBSTANCES.** S. P. Yarmonenko. Med. Radiol. 4, No. 3, 52-7(1959) Mar. (In Russian)

With the aid of luminiscent microscopy of the bone marrow in white rats, subjected to the action of radiomimetic substances from the group of chlorethylamines and chlorethylsulfates, micronecrotic foci are seen, which are similar to those described by M. N. Meisel and co-authors in irradiated animals (Doklady Akad. Nauk 81, 6(1951)). The luminescent phenomenon appears earlier than changes in the peripheral blood and histopathological changes in the bone marrow. In view of this, luminescent microscopy of the bone marrow may be effectively employed for early diagnosis of experimental affection caused by radiomimetic substances. (auth)

## 14203

THE LUMINESCENCE OF DNA ISOLATED FROM TISSUES OF IRRADIATED ANIMALS. G. P. Toropova and A. L. Pozdnyakov. Med. Radiol. 4, No. 3, 57-60(1959) Mar. (In Russian)

X irradiation of animals produces a change of the physico-chemical properties of DNA, manifested by an increase of the intensity of fluorescence of DNA preparations in the presence of fluorochromes. The rise in fluorescence as well as the change of the content of nitrogen in the molecule, takes place soon after irradiation of the animals and fades away at the moment of the reduction of nitrogen and phosphorus constituents in DNA. (auth)

## 14204

OBTAINING SODIUM CHROMATE ( $\text{Na}_2\text{Cr}^{51}\text{O}_4$ ) AND CHROMIUM CHLORIDE ( $\text{Cr}^{51}\text{Cl}_3$ ) AND THEIR USE FOR LABELLING ERYTHROCYTES AND PLASMA PROTEINS. M. M. Golutvina, M. G. Shitikova, V. I. Levin, and R. V. Lenskaya (Ministry of Health, USSR). Med. Radiol. 4, No. 3, 61-5(1959) Mar. (In Russian)

A method is described for preparing non-toxic sodium chromate and chromium chloride containing  $\text{Cr}^{51}$ . It is shown that chromium chloride combines well with plasma protein and can be used for determining the volume of circulating plasma. A method of labeling erythrocytes is also described. (R.V.J.)

## 14205

ABSORPTION AND METABOLISM OF  $\text{B}_{12}$ - $\text{Co}^{60}$  IN HEALTHY AND DYSTROPHIC CHILDREN.

C. Imperato, C. Giovannelli, F. D. Battistini, and G. Ghirardini (Universita, Parma, Italy). Minerva nucleare 3, 100-4(1959) Apr. (In Italian)

Cobalt-60 labelled vitamin  $\text{B}_{12}$  was administered orally or parenterally to healthy and dystrophic children. In the oral administration no differences in the absorption were observed between the two groups of children. The parenteral administration of non-labeled  $\text{B}_{12}$  following the oral administration caused urinary excretion of a large fraction of the activity absorbed. If non-labeled  $\text{B}_{12}$  is given parenterally three days before the oral administration, the fraction of the activity absorbed is only 2.30%. No detectable absorption was observed if non-labeled  $\text{B}_{12}$  is given twice, 6 and  $1\frac{1}{2}$  hr before the oral administration. In the parenteral administration of labeled  $\text{B}_{12}$  there was very high elimination in both groups of children. High elimination was also observed if non-labeled  $\text{B}_{12}$  had been administered four and two days before the labeled vitamin. The counting rate on the liver shows that the fraction picked up by the liver is roughly inversely proportional to the amount absorbed. The activity remains unchanged over a long period of time, approximately 10 months. Parenteral administration of labeled  $\text{B}_{12}$  10 days after the first dose does not appreciably change the liver activity. (auth)

## 14206

THE ARTIFICIAL DEVELOPMENT OF AN INCREASED RESISTANCE TO  $\gamma$  RADIATION IN *E. COLI*.

G. Schabinski, W. Ahlendorf, and F. Schwabe (Friedrich-Schiller (Universitt, Jena, Ger.)). Naturwissenschaften 46, 268(1959). (In German)

*Escherichia coli* were exposed to gamma radiation of 30,000 to 35,000 rep. Those surviving were transferred to new nutrient and again irradiated. In this manner cultures resistant to up to 70,000 rep were obtained. The behavior of such colonies were compared to the be-

havior of non-irradiated colonies in nutrient solutions containing  $\text{H}_2\text{O}_2$ . The results showed that the "radiation resistant" *E. coli* were more quickly acclimated to the  $\text{H}_2\text{O}_2$  environment than the non-irradiated colonies. (J.S.R.)

## 14207

RADIATION INACTIVATION OF ENZYMES, NUCLEIC ACIDS, AND PHAGE PARTICLES. Ernest Pollard (Yale Univ., New Haven, Conn.). Revs. Modern Phys. 31, 273-81(1959) Apr.

Studies directed at cell structure and function are reported. The general character of radioinactivation is treated first. The results of quantitative studies on proteins and on nucleic acids are presented and evaluated. An example of a radiation study on dry protein is given. Studies of virus inactivation, bacteriophage changes, and Newcastle disease and influenza virus are also reported. (T.R.H.)

## 14208

SOME ASPECTS OF CELLULAR RADIOBIOLOGY. T. H. Wood (Univ. of Pennsylvania, Philadelphia). Revs. Modern Phys. 31, 282-8(1959) Apr.

The effects of radiation on the loss of ability of an irradiated *Saccharomyces cerevisiae* cell to produce a visible colony were studied. The studies included dependence of radiosensitivity on oxygen, temperature, cellular water, and phase state. Some generalizations on cellular radiobiology are included. (T.R.H.)

## 14209

EFFECTS OF RADIATIONS ON POPULATIONS OF CELLS AND MULTICELLULAR ORGANISMS.

Cornelius A. Tobias (Univ. of California, Berkeley). Revs. Modern Phys. 31, 289-96(1959) Apr.

A review-discussion is presented including the following topics: cell-division delay and inhibition, extent of damage in nuclear material, post irradiation changes in nuclear material, changes in radioresistance, recovery from mutational deficiencies, cytoplasmic effects of penetrating radiation in terms of information theory, populations of cells in the animal body, yeast-cell populations in the steady state, radiation effects on mammals and man, radiosensitive tissues, indirect radiation effects, longevity, and carcinogenesis. (T.R.H.)

## 14210

POPULATION SIZE REQUIRED FOR INVESTIGATING THRESHOLD DOSE IN RADIATION-INDUCED LEUKEMIA. Carol Buck (Univ. of Western Ontario, London, Can.). Science 129, 1357-8(1959) May 15.

Studies of leukemia in populations receiving small amounts of radiation are needed to investigate the question of a threshold dose. Estimates have been made of the population sizes required to detect a statistically significant increment of leukemia at specified low exposures, by means of the dose-response relation observed by Court-Brown and Doll at high doses. (auth)

## 14211

LOW-LEVEL X-RAY DAMAGE TO AMPHIBIAN ERYTHROCYTES. Milton A. Lessler (Ohio State Univ., Columbus). Science 129, 1551-3(1959) June 5.

*In vitro* x irradiation of frog and *Amphiuma* erythrocytes caused cytophysiological damage to part of the cell population. There was a significant decrease in the percentage of normal cells and some hemolysis. Changes were also observed in the electrical capacitance and potassium-42 uptake of irradiated erythrocytes. (auth)



## 14212

PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, HELD IN GENEVA, 1 SEPTEMBER-13 SEPTEMBER 1958. VOLUME 25. ISOTOPES IN BIOCHEMISTRY AND PHYSIOLOGY, PART 2. Geneva, United Nations, 1958. 306p. \$11.00.

Applications of radioisotopes in studies in the fields of biochemistry and physiology are reviewed. Emphasis is placed on studies on organic metabolism, protein synthesis, endocrinology, and studies using tritium or deuterium as tracers. (C.H.)

## CHEMISTRY

## General

## 14213 AECD-4283

Carbide and Carbon Chemicals Co. [K-25 Plant], Oak Ridge, Tenn.

GAS TITRATION METHODS FOR URANIUM HEXAFLUORIDE. C. W. Weber. Dec. 2, 1953. Decl. May 27, 1959. 4p. Contract [W-7405-eng-26]. (KLI-2710). \$1.80(ph), \$1.80(mf) OTS.

Preliminary experiments with  $\text{NH}_3$  titration of  $\text{UF}_6$  are discussed. An apparatus of Ni burettes and an Al reactor vessel was used, the titration being followed by pressure differences. The results are used in a discussion of a possible mechanism. (T.R.H.)

## 14214 AECU-4136

Monsanto Chemical Co., Everett, Mass.

ORGANIC COOLANT RECLAMATION. Quarterly Progress Report No. 1 [for] December 15, 1958-March 15, 1959. R. J. Wineman, B. J. Gudzinowicz, D. V. Lopiekes, D. A. Scola, and C. I. Tewksbury. Apr. 15, 1959. 32p. Contract AT(11-1)-705. \$4.80(ph), \$2.70(mf) OTS.

In research on developing a suitable method for organic coolant reclamation, several lines of attack are being followed simultaneously. Model compounds were utilized in initial experiments. For the vapor phase hydrogenation-cracking study, apparatus was constructed and several catalysts screened. A Ni on kieselguhr catalyst was active in converting biphenyl to a mixture of benzene and toluene. Liquid phase hydrogenation techniques are under study for partial reduction of polyphenyls. Apparatus was constructed for trial of the redistribution reaction of benzene with polyphenyls. Development of suitable vapor phase chromatographic techniques for reaction product analysis is in progress. (auth)

## 14215 AECU-4171

General Dynamics Corp. Electric Boat Div., Groton, Conn.

INVESTIGATION OF METHODS FOR RADIOACTIVE RESIN DISPOSAL. Final Report M 786. F. J. Craven. May 19, 1959. 25p. Contract [AT(30-3)-338]. (TSD-59-117). \$4.80(ph), \$2.70(mf) OTS.

Cement-sand-resin and litharge-glycerin-resin were investigated for use in immobilizing confined, contaminated resins from reactor water demineralizer beds. The concrete was not useful in this application because of its sensitivity to the activity in the ion exchange resin, while the litharge-glycerine gave satisfactory results. Experimental procedure and results are discussed. (J.R.D.)

## 14216 AERE-R-2925

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

THE DETERMINATION OF INORGANIC ELEMENTS IN BIOLOGICAL TISSUE. H. J. M. Bowen and P. A. Cawse. Apr. 1959. 40p. \$0.84(BIS).

Practical details of analytical methods which have been used for determining the amounts of a number of elements found in biological tissue are given. The elements discussed include barium, boron, bromine, calcium, chlorine, copper, gallium, iodine, iron, magnesium, manganese, molybdenum, phosphorus, potassium, sodium, strontium, sulfur, vanadium, and zinc, and the methods employed are based on colorimetry, flame photometry, or activation. (auth)

## 14217 AFOSR-TN-58-38

Horizons, Inc., Cleveland.

STUDIES ON RARE EARTH CARBIDES—I. Technical Note No. 1. R. C. Vickery, R. Sedlacek, and Ardys Ruben. Jan. 2, 1958. 19p. Contract AF49(638)-80. (AD-148079).

The synthesis and some properties of the higher carbides of some rare earths are reported. The reaction exploited is that between rare-earth oxides and carbon at high temperatures and under low pressures of argon. Carbide formation proceeds via metal production, and interstitial compounds can exist of rare-earth metal held in the carbide lattice. The higher carbides ( $\text{LaC}_2$ ) adopt a tetragonal structure, but scandium differs from the Lanthanons and yttrium in forming only a hexagonal monocarbide ( $\text{ScC}$ ); this is basically attributed to the small size of the scandium ion which sterically permits its association with only one carbon atom. (auth)

## 14218 AFOSR-TN-58-57

Purdue Univ., Lafayette, Ind.

LITERATURE REVIEW ON PROPERTIES OF PRASEODYMIUM AND CERIUM OXIDES. J. M. Honig. Jan. 1958. 65p. Contract AF18(603)-45. (AD-148098).

A review of information on the chemical properties of  $\text{Ce}_2\text{O}_3$  and  $\text{Pr}_2\text{O}_3$  is presented. Crystal structure, stoichiometry, and magnetic and electrical properties are discussed. (110 references). (T.R.H.)

## 14219 AFOSR-TN-58-593

Horizons, Inc., Cleveland.

STUDIES ON RARE EARTH CARBIDES—III. Technical Note No. 3. R. C. Vickery, R. Sedlacek, and Ardys Ruben. July 17, 1958. 13p. Contract AF49(638)-80. (AD-162117).

K-edge absorption of some rare-earth carbides has been studied in further attempts to rationalize the structure of these compounds. The attainment of bivalent states in samarium and ytterbium carbides receives further confirmation, while from consideration of energy values the "free electron" concept appears substantiated. (auth)

## 14220 AFOSR-TN-58-594

Horizons, Inc., Cleveland.

STUDIES ON RARE EARTH CARBIDES—II. Technical Note No. 2. R. C. Vickery, R. Sedlacek, and Ardys Ruben. July 17, 1958. 8p. Contract AF49(638)-80. (AD-162118).

The intrinsic paramagnetism of trivalent rare earth ions is shown to be affected only to a minor degree upon carbide formation. Except for samarium and ytterbium carbides, the small negative difference noted between



theoretical and observed magnetism is attributed to partial spin coupling or quenching of the orbital angular moments. As carbides, samarium and ytterbium are considered to adopt their bivalent states. Bohr magneton numbers and Curie-Weiss constants are presented for the carbides studied. (auth)

#### 14221 ANL-6003

Argonne National Lab., Lemont, Ill.

VAPOR-LIQUID EQUILIBRIUM IN THE SYSTEM BROMINE PENTAFLUORIDE-URANIUM HEXAFLUORIDE. Robert C. Liimatainen. May 1959. 129p. Contract W-31-109-eng-38. \$2.75(OTS).

The vapor pressure of bromine pentafluoride, at temperatures above its boiling point, is given by the equation  $\log_{10} P_1^0 = 6.4545 - 0.01101t - +895/t + 206$  where  $P_1^0 = \text{mm Hg}$ ,  $t = ^\circ\text{C}$ . The values for the vapor pressure of bromine pentafluoride predicted by this equation were checked to within  $\pm 0.5\%$  at four temperature levels in the range 81.3 to 89.4°C. It is believed, therefore, that the values for the vapor pressure of bromine pentafluoride reported by Ellis and Johnson are in error by amounts ranging from +6 to +14% over the range 60 to 90°C. The compressibility factors of saturated vapor mixtures of bromine pentafluoride and uranium hexafluoride were found to be 0.936 at 70°C and 0.917 at 90°C. These values are in excellent agreement with the values predicted from Berthelot's equation of state and from generalized correlations in terms of reduced properties. It was found that measurement of the vapor density of saturated uranium hexafluoride-bromine pentafluoride mixtures could serve as a useful technique for the determination of composition to within  $\pm 1\%$ . To obtain reliable data on the vapor-liquid equilibria in the system bromine pentafluoride-uranium hexafluoride, it was found necessary to introduce elemental fluorine to the extent of about 10 mm Hg partial pressure to insure that extraneous chemical species such as  $\text{Br}_2$ ,  $\text{BrF}$ , or  $\text{BrF}_3$  were not formed. The binary vapor-liquid system bromine pentafluoride-uranium hexafluoride shows positive deviations from ideality. Activity coefficients can be correlated as a function of composition by the symmetrical relationships of the form  $\log_{10} \gamma_2 = AX^2$  and  $\log_{10} \gamma_1 = A(1-X)^2$  where the constant  $A$  has the value 0.114 at 70°C. This value corresponds to a limiting value of the activity coefficient of 1.30. The three atmosphere isobar as computed from isothermal data at 70 and 90°C has relative volatilities ranging from  $\alpha = 1.80$  at  $X \rightarrow 0$  to  $\alpha = 1.09$  as  $X \rightarrow 100\%$  bromine pentafluoride. Comparisons made with published results on distillation of the binary, condensed equilibria, and the theory of regular solutions all indicate that the bromine pentafluoride-uranium hexafluoride shows small positive deviations from ideality with no azeotrope. It is believed that the difference in results obtained in this investigation using a mechanical, vapor recirculation, equilibrium still can be explained at least in part by the fact that in this study fluorine was used, whereas in the static still elemental fluorine was not present. (auth)

#### 14222 BNL-4131

Brookhaven National Lab., Upton, N. Y. and Columbia Univ., New York.

CATALYSIS OF THE IRON(II)-IRON(III) ELECTRON EXCHANGE REACTION BY SOME ORGANIC ANIONS. R. A. Horne. [1959]. 4p. \$1.80(ph), \$1.80(mf) OTS.

The rate of the  $\text{Fe}^{2+}$ - $\text{Fe}^{3+}$  electron exchange reaction in aqueous solutions of acetic, oxalic, benzoic, fumaric, o-phthalic, succinic, and carboxylic acids was determined. (T.R.H.)

#### 13223 HW-59780

General Electric Co. Hanford Atomic Products

Operation, Richland, Wash.

EVALUATION OF MATERIALS FOR USE AS ANODES IN THE FLUREX PROCESS. W. W. Schulz and E. W. Neuvar. Feb. 15, 1959. 23p. Contract W-31-109-Eng-52. \$0.75(OTS).

The anodic corrosion of several readily available materials in synthetic Flurex Process anolyte solutions of the composition  $0.1 \text{ M NH}_4\text{NO}_3$ ,  $0.0003 \text{ M NH}_4\text{F}$ , pH 7-9 was measured to provide a basis for the selection of satisfactory anode materials. Of the materials tested, Pt and the stainless steels 304 L and 347 were selected for more extensive tests. Anodic corrosion rate measurements over the entire span of probable Flurex Process operating conditions showed that Pt and stainless steels 304 L and 347 are satisfactory anode materials for use in the process. Based on the anodic corrosion rates obtained, it is estimated that the cost of anode material dissolved per pound of U processed in the electrolytic cell would be about 0.4 cent for either SS 304 L or 347 and about 1.4 cents for Pt. The anodic corrosion of Pt in  $\text{HNO}_3$  solutions was also investigated. (auth)

#### 14224 IDO-14460

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

SPECTROPHOTOMETRIC STUDY OF THE TERNARY SYSTEM, ALUMINUM NITRATE-NITRIC ACID-WATER. APPLICATION TO ANALYSIS. Robert W. Henry and Glenn L. Booman. Mar. 31, 1959. 10p. Contract AT(10-1)-205. \$1.80(ph), \$1.80(mf) OTS.

The ternary system aluminum nitrate-nitric acid-water was studied spectrophotometrically. Acid and aluminum concentrations are determinable by measuring absorbances at 295 mμ and 2.667μ. This study appears worthy of evaluation as the basis of an in-line measuring system. (auth)

#### 14225 ISC-934

Ames Lab., Ames, Iowa

THE HEATS OF COMBUSTION OF SOME RARE-EARTH METALS. F. H. Spedding, R. E. Eberts, and A. W. Naumann. May 15, 1959. 16p. Contract W-7405-eng-82. \$0.50(OTS).

A bomb calorimeter for measuring the heats of combustion of Nd, Sa, Gd, and Er is described. The heats of combustion and the heats of formation of their oxides are reported. (auth)

#### 14226 ISC-1021

Ames Lab., Ames, Iowa.

AN AUTOMATIC RECORDING TITRATOR. Gerald Ross Umbreit and J. S. Fritz. Dec. 1957. 53p. Contract W-7405-eng-82. \$1.50(OTS).

An automatic recording titrator is described which is applicable to all types of potentiometric titrations. Particular attention has been paid to the maintenance of accurate potential recording of the entire titration curve as well as accurate recording of the volume of titrant used. As a result the instrument is well-suited for analytical research where the complete curve, rather than just the equivalence point of the titration is of interest. Simplicity of the instrument is maintained by use of commercially available components for the major functions of amplifying and recording. Each of the major components retains its separate identity, and thus may be used for other applications without alterations. Acceptable substitutes for each of the major components are suggested, and the relative merits of



each are discussed. Suggestions for improving the instrument are also discussed. (auth)

#### 14227 ISC-1071

Ames Lab., Ames, Iowa.

#### TRANSPORT NUMBERS IN FUSED SILVER

#### CHLORIDE-ALKALI METAL CHLORIDE SYSTEMS.

Allen Lee Bowman and F. R. Duke. Aug. 1958. 41p.

Contract W-7405-eng-82. \$7.80(ph), \$3.30(mf) OTS.

The transport number of the  $\text{Cl}^-$  ion was determined directly by following the migration of  $\text{Cl}^{36}$  in the alkali metal chlorides,  $\text{AgCl}$ , and mixtures of  $\text{AgCl}$  with  $\text{LiCl}$ ,  $\text{NaCl}$ , and  $\text{KCl}$ . The transport numbers of the cations were determined by measurement of  $\Phi$  or by following the migration of  $\text{Ag}^{109m}$ . Also a set of equations is proposed with adjustable parameters to describe the conductivity, fluidity, self-diffusion, and transport numbers in a pure fused salt. (J.R.D.)

#### 14228 KAPL-M-LMO-2

Knolls Atomic Power Lab., Schenectady, N. Y.

#### THICKNESS MEASUREMENTS OF $\text{ZrO}_2$ FILM ON COR-

#### ROSION TESTED ZIRCALOY II. L. M. Osika. May 21,

1959. 7p. Contract W-31-109-Eng-52. \$1.80 (ph),

\$1.80 (mf) OTS.

An x-ray-diffraction analysis was applied to the measurement of a corrosion film on corrosion tested Zircaloy II. Coating thicknesses in the range of  $10^{-6}$  to  $10^{-2}$  cm can be determined. The method is generally applicable to coatings of any material where x-ray-absorption coefficients are known. (J.R.D.)

#### 14229 NAA-SR-3371

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

#### THE BISMUTH-BISMUTH TRICHLORIDE SYSTEM.

S. J. Yosim, A. J. Darnell, W. G. Gehman, and S. W. Mayer. May 1, 1959. 10p. Contract AT-11-1-gen-8. \$0.50 (OTS).

A phase equilibrium study of the bismuth-bismuth trichloride system was carried out. The experimental techniques included sampling at temperature, thermal analysis, and visual observations. The miscibility gap was found to be closed at a consolute temperature of  $780^\circ\text{C}$  and 51 mole % Bi. In the two liquid phase region, the solubility of the salt in the metal increased with increasing temperature, while the solubility of the metal in the salt decreased from 45% at  $320^\circ\text{C}$  to 28% at about  $550^\circ\text{C}$ . Results in the liquid-solid region are reported and compared with those of earlier workers. (auth)

#### 14230 NAA-SR-3452

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

#### LATTICE DEFECTS IN TRANSITION METAL HY-

DRIDES. G. G. Libowitz. June 1, 1959. 14p. Contract AT-11-1-GEN-8. \$0.50 (OTS).

A method of determining the type of defect present in nonstoichiometric transition metal hydrides is described. The method is applied to the uranium-hydrogen, palladium-hydrogen, zirconium-nickel-hydrogen, and zirconium-hydrogen systems. The energies necessary to form a defect, and interaction energies of defects are calculated from pressure-composition-temperature data. (auth)

#### 14231 NASA-M-1-27-59E

National Aeronautics and Space Administration, Lewis Research Center, Cleveland.

#### DESIGN AND OPERATING CRITERIA FOR FLUORINE DISPOSAL BY REACTION WITH CHARCOAL.

Harold W. Schmidt. Feb. 1959. 18p.

Design and operational criteria were determined for the utilization of the charcoal-fluorine reaction for fluorine disposal. The disposal-rate limit was found to be inversely proportional to the charcoal-bed particle diameter. Fluorine dilution and moisture content of the charcoal do not affect the reaction significantly. (auth)

#### 14232 NP-7394

Mine Safety Appliances Co., Callery, Penna.

#### MIXING OF RESIDUAL SODIUM WITH A SODIUM

#### FLUSH. Report 2. Memo Report 68. E. F. Batutis,

J. K. Powledge, and J. W. Mausteller. Nov. 4, 1954.

8p. Contract NObs-65426.

Residual sodium left on draining a 1 in. pipe loop was partially removed by a sodium flush at  $650^\circ\text{F}$ . The maximum practical decontamination was done in 4 hr at a flowrate corresponding to  $\text{Re} = 38,000$ . In this time mixing was 88% of that obtained in a total of 33 hr. (auth)

#### 14233 NP-7514

#### KINETIKA VOSSTANOVLENIYA AMERITSIYA(V)

#### PEREKIS' YU VODORODA. (Kinetics of Americium(V)

#### Reduction by Hydrogen Peroxide.) A. A. Zaitsev, V. N.

Kosyakov, A. G. Rykov, Yu. P. Sobolev, and G. N.

Yakovlev. [nd]. 9p.

The kinetics of americium(V) reduction by hydrogen peroxide in 0.1 M hydrochloric acid was investigated. The reactor rate constants determined at 25, 30, and  $35^\circ\text{C}$  were  $14.8 \pm 1.5$ ,  $21.6 \pm 2.2$ , and  $30.3 \pm 3.0$  moles/l/hr. The reaction activation energy (Arrhenius) and the activated complex enthalpy changes were  $\Delta E = 13.3$  kcal/mole and  $\Delta H^\ddagger = 12.7$  kcal/mole. (tr-auth)

#### 14234 NP-7516

#### TEPLYOTY SUBLIMATSHI TETRAFTORIDOV URANA,

#### NEPTUNIYA, PLUTONIYA I AMERITSIYA. (Heat of

#### Sublimation of Uranium, Neptunium, Plutonium, and

#### Americium Tetrafluorides.) E. G. Chudinov and D. Ya.

Choporov. [nd]. 3p.

The vapor pressure and heat of sublimation of active element fluorides were studied in relation to the pyrometallurgical treatment of nuclear fuels. A modified Knudsen method was used for measuring the tetrafluoride vapors. Radiometric measurements of the quantity of evaporated materials were made starting with the specific activity of the investigated materials. Measurements were made on  $\text{UF}_4$  (using the isotopes of  $\text{U}^{233}$  and mixtures of  $\text{U}^{233}$  and  $\text{U}^{238}$ ),  $\text{NpF}_4$  and  $\text{PuF}_4$  (using isotopes of  $\text{Np}^{237}$  and  $\text{Pu}^{239}$ ), and  $\text{AmF}_4$  (using  $\text{Am}^{241}$ ). The tables of sublimation heat and entropy calculated from the obtained vapor pressure values are presented, including data on  $\text{ThF}_4$ . (R.V.J.)

#### 14235 NP-7517

#### DISPROPORTSIONIROVANIE AMERITSIYA(IV).

#### (Disproportionation of Americium(IV).) A. A. Zaitsev,

V. N. Kosyakov, A. G. Rykov, Yu. P. Sobolev, and G. P.

Yakovlev. [nd]. 7p.

Qualitative studies were made of the americium(IV) disproportionation reaction in sulfuric acid solutions. The total disproportionation reaction is  $3 \text{Am(IV)} \rightarrow 2 \text{Am(III)} + \text{Am(VI)}$ , following two parallel reactions:  $2 \text{Am}^{4+} + 2 \text{H}_2\text{O} \rightarrow \text{Am}^{3+} + \text{AmO}_2^+ + 4 \text{H}^+$ ,  $\text{Am}^{4+} + \text{AmO}_2^+ \rightarrow \text{Am}^{3+} + \text{AmO}_2^{2+}$ . (tr-auth)

#### 14236 NP-7536

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

#### STUDIES ON THE SEPARATION OF THE RARE

#### EARTHS FROM THORIUM IN SULPHATE SOLUTIONS,

USING CATION EXCHANGE RESINS. D. C. Lewis and J. C. Ingles. Oct. 6, 1958. 45p. (R-31).

An ion exchange method for the separation of the rare earth elements from thorium has been investigated. The method is based on the difference in the extent of complexing of the metal ions by sulfate ions in aqueous solution. Variables investigated were: sulfate concentration, nature of the counter-ion (i.e., the cation whose sulfate salt supplies the sulfate for complexing), and resin type. Separation was not quantitative but it was found possible to obtain reasonable recoveries of thorium free of rare earths. The application of the law of mass action to the solution and resin equilibria was undertaken in an attempt to explain the data. The theoretical expression obtained was not, however, in complete agreement with the experimental results. (auth)

**14237** NP-7538

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

THE "THORIN" COLORIMETRIC METHOD FOR THORIUM DETERMINATION: EFFECT OF SOME COMMON IONS, AND METHODS FOR OVERCOMING INTERFERENCES. J. A. F. Bouvier and R. J. Guest. Nov. 26, 1958. 17p. (R-34).

The effect of a number of common ions on the Thorin colorimetric method for Th determination were investigated. A comparison was carried out on the use of the two reducing agents, ascorbic acid and hydroxylamine hydrochloride, for overcoming the interference of Fe and Ce. Mo caused low Th assays in the presence of ascorbic acid, whereas this effect was not found with hydroxylamine hydrochloride present, or in the absence of a reducing agent. Ti caused low Th assays under any conditions tried and a very low tolerance limit must be set for this ion. Zr caused high Th assays under normal conditions, but its effect varied with the form in which it was added, and appeared to be enhanced by the presence of Th. By using mesotartaric acid as a masking agent for Zr approximately 5 mg of Zr could be tolerated in a final 25 ml volume taken for the colorimetric finish. In the absence of Zr, mesotartaric acid is not required and a final volume of 250 ml is used. (auth)

**14238** NP-7551

Gliwice, Poland. Silesian Coll. of Science and Technology.

RELATIONSHIP BETWEEN BORON CONTENT IN COAL TAR AND COAL PROPERTIES AND CARBONIZATION CONDITIONS. Report No. 67/IV. Z. Frankl and A. Grossman. Feb. 1959. 12p.

Attempts to find raw materials of greater purity for the production of reactor graphite are described. The effects of coal properties and carbonization conditions on the boron content of coal tar were studied. Suitable choice of coal made possible the preparation of tars and pitch cokes containing less than the usual proportion of boron. Extraneous mineral impurities (rock) were found to have no essential effect on the boron content of tars and pitch cokes provided that dust from the coking chamber is not permitted to be carried off into the collecting pipe. (auth)

**14239** NP-7605

Hughes Aircraft Co. Microwave Lab., Culver City, Calif.

RESEARCH ON HIGH TEMPERATURE POLYMERS. Technical Report No. 2 [for] September 1, 1958 to

March 1, 1959. J. B. Rust, C. L. Segal, and H. H. Takimoto. 53p. Contract Nonr-2540 (00).

A detailed study of the synthesis of polymer intermediates of the type  $[(CH_3)_3SiO]_n Ti(OC_2H_5)_{4-n}$  where  $n = 2, 4$ , was conducted; a chemical analysis and infrared spectra analysis were carried out on the products. The postulated structure of the titanium ester intermediates was verified. The reaction of ethyl orthosilicate with trimethylacetoxysilane, to form intermediates analogous to the above titanium esters, produced low yields of the silicon ester when sodium ethylate catalyst was used. Polymers containing a silicon-oxygen-titanium backbone poly(triorganosiloxy)titanosiloxanes, were prepared with several different organic bases as catalyst. The postulated structure was partially confirmed by chemical and infrared analyses. A linear polymer with a molecular weight of 42,300, was obtained by the use of sodium ethylate as catalyst. There was some indication that part of the trimethylsiloxy side groups were cleaved during the reaction or during processing of the polymers. Polymers containing the titanium-oxygen backbone, poly(triorganosiloxy)titanoxanes were prepared and the products identified. Here again there was some indication of cleavage of trimethylsiloxy groups. Polymers containing silicon and aluminum, poly(triorganosiloxy)aluminosiloxanes and poly(triorganosiloxy)aluminoxanes were prepared. (auth)

**14240** NS-1

New Zealand. Dept. of Scientific and Industrial Research. Div. of Nuclear Sciences, Lower Hutt.

CORRECTIONS TO BE APPLIED TO THE ELECTROLYTIC ENRICHMENT FACTOR OF DEUTERIUM AND TRITIUM WHEN WATER IS BEING LOST FROM THE CELL BY ENTRAINMENT AND BY EVAPORATION. A. E. Bainbridge. Jan. 30, 1959. 24p.

During the enrichment of the heavy isotopes of hydrogen in water by electrolysis at a practical rate, there is an invariable loss of water from the cell by entrainment and by evaporation. The spray or entrained water vapor has the same isotopic composition as the electrolyte but due to the difference in the partial pressures of HDO, HTO, and  $H_2O$  there is some enrichment in the evaporated water vapor. The classical theoretical approach to the relationship between the volume reduction and the increase in isotopic concentration does not take into account these losses and in fact in most experiments the losses are too small to affect the electrolytic separation or else there is no need to measure the enrichment accurately. In the enrichment of tritium in natural waters it is necessary to measure the enrichment accurately, and if the electrolysis is to be carried out at a high rate with ordinary cells then corrections must be applied to the observed reduction of volume of the electrolyte, e.g., if the volume is reduced by a factor of 104 and there is a 10% loss of water as spray then the classical enrichment factor for tritium should be multiplied by 0.42 and if the cell is operating at 38°C (i.e., 10% of the water is being lost by evaporation) then the multiplication factor is 0.52. This correction factor decreases as the volume of electrolyte becomes smaller. (auth)

**14241** NYO-7549

Tufts Univ., Medford, Mass.

THE NON-STOICHIOMETRY OF LANTHANUM HYDRIDE. Edward J. Goon. Mar. 30, 1959. 20p. Contract AT(30-1)-1355. \$3.30(ph), \$2.40(mf) OTS.

An interpretation of the thermal expansion data of the La-H system, obtained from a high-temperature



x-ray-diffraction study with the specimen under hydrogen gas pressure, indicates that the hydride exists as a nonstoichiometric compound at elevated temperatures. The nonstoichiometry may be explained by the movement of hydrogen out of the octahedral sites of the hydride lattice without the necessity of forming Schottky defects in the lanthanum lattice of the hydride. The tetrahedral interstices are considered fully occupied by hydrogen. The energy required to create a hydrogen vacancy in the octahedral site was calculated by the method of Lawson from thermal expansion data and found to be 0.10 ev. The good agreement between this energy and energy of formation of a lattice defect is demonstrated by a similar analysis to the thermal expansion data of uranium hydride. (auth)

**14242** ORNL-2738

Oak Ridge National Lab., Tenn.

REVIEW AND BIBLIOGRAPHY ON: DESIGN AND USE OF WINDOWS FOR OPTICAL MEASUREMENTS AT ELEVATED TEMPERATURES AND PRESSURES (1881-1959). R. E. Biggers and J. M. Chilton. June 12, 1959. 88p. Contract W-7405-eng-26. \$2.25(OTS).

The references in this bibliography cover the period from 1881 to 1959 (4/20), and were obtained from many sources. A brief abstract is given along with almost all of the 117 references that are listed. A review of the present and past status of the research effort in this field is given over the entire time period. The general design considerations for the past and present window designs are thoroughly discussed, and each paper is evaluated from the point of view of window design, temperature limits, and pressure limits. The "Poulter" Window designed by T. C. Poulter in 1929 is extensively discussed. About eighty per cent of the window designs and research projects since 1930 have used this design. The Poulter type window has been very satisfactorily used at simultaneous temperatures and pressures up to 1200°C and 1500 atmospheres. The literature is also reviewed from the standpoint of work carried out with the simultaneous use of elevated temperatures and pressures. Future developments are discussed for four different types of window designs that may permit the study of liquids at temperatures higher than 250°C up to at least 330°C and 200 atmospheres pressure, and probably up to the critical temperature of water. Sections are included on the arrangement of the bibliography, an author index, and a brief review of the source material. (auth)

**14243** RFP-78

Dow Chemical Co., Rocky Flats Plant, Denver.

A SPECTROPHOTOMETRIC METHOD FOR URANIUM USING TRI-N-BUTYL PHOSPHATE AND DIBENZOYL-METHANE. J. L. Long and L. F. Grill. July 3, 1957. 20p. Contract AT(29-1)-1106. \$3.30 (ph), \$2.40 (mf) OTS.

The need for a method for the rapid determination of microgram amounts of uranium in the presence of milligram amounts of contaminants led to the development of a spectrophotometric method. Uranyl nitrate is extracted into tri-n-butyl phosphate, where, after buffering with tris(hydroxymethyl)-amino methane and adding ethyl alcohol, the yellow uranium dibenzoylmethane complex is formed. The absorbance of the solution is measured at 405 millimicrons. The molar absorptance index is 16,600. Uranium can be rapidly determined in samples containing much larger quantities of interfering ions by this method. (auth)

**14244** TID-7568(Pt.2)

Oak Ridge National Lab., Tenn.

ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. C. D. Susano, H. P. House, and Margaret A. Marler, eds. Apr. 1959. 242p. \$2.50(OTS).

Nineteen papers are presented in this volume. Separate abstracts have been prepared for each paper. (W.L.H.)

**14245** TID-7568(Pt. 2)(p.3-12)

Oak Ridge National Lab., Tenn.

INSTRUMENTATION FOR CHEMICAL ANALYSES. A. APPLICATIONS OF SEMICONDUCTOR DEVICES TO POTENTIOMETRIC AND COULOMETRIC TITRATIONS. H. C. Jones. B. APPLICATIONS OF OPERATIONAL AMPLIFIERS TO CONTROLLED-POTENTIAL AND DERIVATIVE POLAROGRAPHY. D. J. Fisher. C. APPLICATIONS OF RADIO-FREQUENCY TO REACTOR ANALYSIS. R. W. Stelzner. p.3-12 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. 10p.

The uses of silicon diodes as rectifiers and as meter protectors, Zener diodes as constant-potential sources to replace batteries, and transistors as current amplifiers and as switches are described. The applications of these devices to potentiometric and coulometric titrations are discussed. Commercial operational amplifiers that perform mathematical operations and transformations by means of negative feedback have been used in instrumentation designed for chemical analyses. As an example, the block diagram of the controlled-potential and derivative polarograph will be discussed. Operational amplifiers are used to control, instantaneously and continuously, the potential of the D.M.E. with respect to the solution as seen through a reference electrode, to measure current, to follow the actual peak current reached during the formation of each successive drop and record an  $i_{\max}$  polarogram, to average the current during the formation of each successive drop and record an  $i_{av}$  polarogram, and to take and record the time derivative of the polarographic wave. The  $i_{\max}$  and  $i_{av}$  polarograms do not contain the oscillations due to the growth and fall of the D.M.E. drops. The  $i_{\max}$  polarograms are recorded with no time lag in the  $E_{1/2}$  value. Zero-damped regular polarograms may also be recorded. Because of the wide frequency response of the amplifiers, it is possible to use the polarograph for oscillographic polarography. The potential control amplifier eliminates the  $iR_{\text{cell}}$  loss which is encountered with conventional circuitry. A constant-current parallel transmission line oscillator that operates on a frequency of approximately 250 Mc will be discussed. This instrumentation is used for laboratory-type analyses and for continuous monitoring of the concentration of process streams in test loops. Instrumentation has been developed for monitoring either high-alkali or high-acid concentrations of flowing aqueous streams. (auth)

**14246** TID-7568(Pt. 2)(p.13-23)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

AUTOMATIC ANALYZING MONITOR. H. G. Rieck,

C. A. Ratcliffe, and L. C. Schwendiman. p.13-23 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29—October 1, 1958. 11p.

A monitor is described which automatically measures and records the total beta-emission rate and the concentrations of sodium-24, neptunium-239, arsenic-76, copper-64, manganese-56, phosphorus-32, and silicon-31 in a reactor waste stream. Samples are withdrawn from the waste stream once each hour and transferred to sample dishes. Chemical treatment is used to remove interfering isotopes prior to the transfer of sample. The samples are subsequently dried and then moved through two counting stations by mechanical positioners. A gamma scintillation counter equipped with a pulse-height analyzer is used to provide information from which the manganese-56, copper-64, sodium-24, arsenic-76, and neptunium-239 concentration is measured. The total beta-emission rate and phosphorus-32 and silicon-31 concentrations are measured in a proportional gas-flow, beta counter. Appropriate Compton corrections for interfering isotopes are applied electronically to the data output. A decay track provides a time interval in which interfering isotopes are removed from the sample by radioactive decay. The data are recorded on 5-inch tape and subsequently transcribed to IBM cards for computation and tabulation purposes. (auth)

**14247** TID-7568(Pt. 2)(p.24-32)  
MSA Research Corp., Callery, Penna.  
OPERATING EXPERIENCES WITH OXIDE MONITORS FOR SODIUM SYSTEMS. E. F. Batutis. p.24-32 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29—October 1, 1958. 9p.

The control of oxides in alkali-metal heat-transfer systems is necessary from an operational and corrosion standpoint since the inception of these metals as heat transfer media. "Wet" chemical methods for determining the degree of control are satisfactory for concentrations as low as 0.002 weight per cent of  $O_2$ . Remote-control monitors have been developed with similar detection limits. In these devices, oxide concentrations are determined by observing the temperature at which oxide precipitates in a cooled by-pass stream, as indicated by an increase in resistance to flow. These so-called plugging indicators have given consistent and reliable results. The development of and the recent operational experience with these indicators in both large and small systems are also discussed. (auth)

**14248** TID-7568(Pt. 2)(p.33-41)  
Pratt and Whitney Aircraft Hot Cell Facility, Livermore, Calif.

INSTRUMENTATION FOR X-RAY DIFFRACTION STUDIES OF HIGHLY RADIOACTIVE SAMPLES. V. G. Scotti, J. I. Mueller, and J. J. Little. p.33-41 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29—October 1, 1958. 9p.

With the advent of nuclear engineering, x-ray diffraction has become an important analytical tool in the study of radiation damage of reactor components due to neu-

tron and gamma-ray irradiation. The materials under study in this work have radioactive levels up to 40 r per hour of combined beta and gamma activity at 17 cm. The activity of the samples in this study is due to  $(n,\gamma)$  reactions and fission products. Data are presented to illustrate the use of sample shielding, detector shielding, pulse-height discrimination, and the combination of all three aids in an effort to attain the most favorable peak-to-background ratio. It is also shown that true peak intensities and resolution are obtained. (auth)

**14249** TID-7568(Pt. 2)(p.42-51)  
Pratt and Whitney Aircraft Hot Cell Facility, Livermore, Calif.

FLUORESCENT X-RAY ANALYSIS OF HIGHLY RADIOACTIVE SAMPLES. J. I. Mueller, V. G. Scotti, and J. J. Little. p.42-51 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29—October 1, 1958. 10p.

The use of lead shielding and pulse-height discrimination in x-ray fluorescent analysis as aids in reducing the background counts due to radioactive samples is described. The level of radioactivity of the samples considered in this study approached 40 r per hour of combined beta and gamma activity at 17 cm. Data are presented to illustrate the effectiveness of both shielding and pulse-height discrimination, either separately or in combination. (auth)

**14250** TID-7568(Pt. 2)(p.55-64)  
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

REMOTE ANALYTICAL FACILITY OPERATIONAL EXPERIENCES. George A. Huff. p.55-64 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29—October 1, 1958. 10p.

The benefits and operational experiences of the Remote Analytical Facility at the Idaho Chemical Processing Plant are described. A comparison is made of the original remote laboratory to the new Remote Analytical Facility which was described in *Analytical Chemistry* 28, 1084 (1956). It is shown that simple remote handling techniques are at times overlooked in preference to those which are more complex. It is pointed out that the new facility adequately fills its need. Advantages afforded by the new facility are discussed. The time required for carrying out analyses by direct and remote techniques are compared. A comparison is also made of the precisions which can be attained when remote handling and direct bench top techniques are used in chemical analyses. (auth)

**14251** TID-7568(Pt. 2)(p.65-75)  
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

REMOTE PIPETTER FOR HIGHLY RADIOACTIVE SAMPLES. Fred W. Dykes. p.65-75 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29—October 1, 1958. 11p.

The Remote Analytical Facility of the Idaho Chemical Processing Plant is in operation 24 hours a day for the



analysis of highly radioactive liquid samples. The most important analytical apparatus in this facility is the remote pipetter which delivers sample aliquots for the various analytical determinations. The first pipetter used was patterned after one designed at Oak Ridge National Laboratory. Based upon operating experience with it, a revised unit has been designed. This new model, termed the RAF model B pipetter, utilizes the basic, proven features of the ORNL design while incorporating modifications to reduce maintenance requirements as well as to facilitate maintenance and decontamination procedures. The pipetter is a positive displacement, motor-driven type and employs the same Brown continuous-balance control system used previously. However, the upper inlet to the sample chamber is no longer controlled by the plunger but by an air-operated diaphragm valve. This feature permits instantaneous shutoff when full, simplifies the plunger design, reduces the possibility of plugging by eliminating small passageways, and permits filling or cleaning of the pipetter at any plunger position. Pipetter alignment is no longer accomplished by positioning the plunger but by rotating the balancing potentiometer. This permits disassembly of the sample-handling components without necessitating a tedious job of realignment. All susceptible parts, such as the servomotor, potentiometer, and gears, are enclosed in a housing which is maintained under slight positive pressure. This permits use of remote decontamination procedures without risk of damage to the mechanism. Many other minor improvements were made both in the pipetter design and the design of auxiliary apparatus used in conjunction with the pipetter. The end result is a remote pipetter designed to operate continuously under difficult conditions, with minimum maintenance. (auth)

**14252** TID-7568 (Pt. 2) (p.76-84)

Argonne National Lab., Lemont, Ill.  
ANALYTICAL CAVE OPERATIONS ON FUEL PROCESSING DEVELOPMENT SAMPLES. R. P. Larsen, J. J. McCown, and W. R. Sovereign. p.76-84 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. 9p.

In support of the program for the development of methods for processing reactor fuel by the Chemical Engineering Division at Argonne National Laboratory (ANL), a wide variety of nonrepetitive analytical and related operations must be carried out on highly irradiated materials. With only a single junior cave (10 curies of 1 Mev gamma) available for this type of work, it has been necessary to adopt an operational philosophy which preserves versatility through simplicity of methods and the design of basic cave equipment. In practice, it has been found that most of these operations can be done in the cave almost as simply as they would be done outside the cave on inert materials. Because equipment can be set up, an operation carried out, the equipment dismantled and a second set-up installed in a single working day, maximum utilization of the cave is achieved. A representative group of the operations carried out on samples obtained from fuel processing programs have been selected for discussion. These include: the opening of sealed irradiation cans; the cutting and trimming of NRX-type fuel elements by electrolytic dissolution techniques; separation of xenon-133 (5.3 d), krypton-85 (10.4 y), bromine-83 (2.3 h), and iodine-131

(8.0 d) from samples obtained in the study of pyrometallurgical processing; solvent extraction decontaminations of uranium and plutonium of high atom burn-up; and the separation of fission product ruthenium as a measure of uranium in irradiated fused salts. (auth)

**14253** TID-7568 (Pt. 2) (p.85-90)

Knolls Atomic Power Lab., Schenectady, N. Y.  
THE DETERMINATION OF HYDROGEN IN IRRADIATED REACTOR MATERIALS. F. K. Heumann and L. A. Altamari. p.85-90 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. 6p.

Hydrogen is determined in irradiated reactor materials by the hot extraction method at a temperature of approximately 1080°C. Samples weighing from 2 to 4 g and containing from 30 to several hundred ppm of hydrogen have been analyzed by this method. Values can also be obtained for the xenon and krypton content since the gas is analyzed by the mass spectrometer. The samples, each having a radiation intensity of approximately 500 r, are handled remotely. They are weighed and sectioned in one cell and then transferred by cask to the hot-extraction cell. Here they are washed in  $\text{CCl}_4$  and placed in a quartz furnace tube. This tube is connected to a line from the hot-extraction system with a ball and socket joint. Heating is done with a resistance furnace fitted on a small dolly. All operations are done with a manipulator, and viewing is done through a zinc bromide-lead glass window. The hot-extraction vacuum system, which is external to the hot cell, is contained in a box which exhausts into the cell. The system has a calibrated volume for gas collection, a manometer and McLeod gage for pressure readings, and facilities for taking gas samples. The gas released from the sample is pumped to the collecting container with an Hg diffusion pump and a Toepler pump. (auth)

**14254** TID-7568 (Pt. 2) (p.91-141)

Oak Ridge National Lab., Tenn.  
REMOTELY CONTROLLED ANALYTICAL FACILITIES FOR THE ANALYSIS OF SAMPLES FROM THE HOMOGENEOUS REACTOR. PARTS A THROUGH E. Cyrus Feldman, W. R. Musick, A. D. Horton, L. G. Farrar, B. B. Hobbs, W. D. Shults, M. T. Kelley, R. W. Stelzner, D. J. Fisher, U. Koskela, J. E. Attrill, and J. L. Mottern. p.91-141 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. 51p.

Sample preparation and excitation are performed in a shielded cell by means of manipulators. Light is conducted out of the cell by relay lenses into an Ebert spectrograph. Brief descriptions are given of the chemical treatment and excitation of (1) Homogeneous Reactor fuel and process solutions, (2) radioisotope preparations, and (3) miscellaneous solids of unknown composition. Special auxiliary devices and decontamination procedures are also described. An adaptation of Booman's mercury cathode cell to facilitate the remote-control, coulometric analysis of Homogeneous Reactor fuel is described. The important features of the analysis are outlined and pertinent data are given. An improved servo-controlled, remotely operated pipetter has been designed for use in the High-Radiation-Level Analytical Facility (HRLAF). It is a component of in-

strumentation designed for the remote determination on the density of very radioactive samples by the falling-drop method. Instrumentation for the precise determination of the density of highly radioactive liquids by the falling-drop technique is discussed. The following units comprise the instrumentation: a 0.1-ml servo-driven pipet that delivers 5- $\mu$ l samples, a screw-driven elevator, a lazy-susan sample bottle holder, a motor-driven turret that indexes six fall-tubes, a thermostatted bath (30°C), an ORNL Q-1348 pipetter control unit, an ORNL Q-1551 photoelectric timer, and a thyratron bias monitor. The falling-drop densimeter has been operated in the HRLAF for the determination of the density of Thorex process solutions and of high-percentage heavy-water solutions. Relative standard deviations of results average 0.2 to 0.3 per cent. The analytical operational experiences in the HRLAF during recent power operations of the Oak Ridge Homogeneous Reactor (HRT) are described. Among the subjects discussed are sample receiving and unloading, cell and manipulator maintenance, sampling, sample storage and disposal, and decontamination. (auth)

**14255** TID-7568(Pt. 2)(p.145-57)

Oak Ridge National Lab., Tenn.

SPECIAL RADIOCHEMICAL ANALYSIS IN THE OPERATION OF ORNL REACTORS. G. W. Leddicotte and W. S. Lyon. p.145-57 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. 13p.

The extensive reactor-development program, such as that being conducted at the Oak Ridge National Laboratory, involves a large number of unusual radiochemical analyses, including such analyses as may be necessary in the processing of fuel, the fabrication and testing of fuel elements, and in the usage of other materials in the operation of reactors. In connection with the homogeneous reactor test, analyses have been made of solid, liquid, and gaseous samples, and isotopic ratios have been determined for a number of radioactive species, including the fission-product isotopes of Ce, Cs, Ru, and I. Methods have also been devised for the determination of low concentrations of induced activities in the presence of high concentrations of fission products. In addition, much work has been done in connection with the operation of reactors, including the identification and source of radioactive nuclides in the cooling-water systems of the Low-Intensity Test Reactor (LITR), the Bulk Shielding Reactor (BSR), and the Oak Ridge Research Reactor (ORR). Radiochemical methods, complemented by the techniques of neutron activation analysis, were used in the performance of this work. The neutron activation analysis of materials which are being used in special reactor experiments, the particle-size distribution of radioactive corrosion products which are found in a reactor, and the monitoring of the apparent neutron flux in connection with experiments in a reactor irradiation facility are also described briefly. (auth)

**14256** TID-7568(Pt. 2)(p.158-77)

National Lead Co. of Ohio, Cincinnati.

THE DETERMINATION OF URANIUM-235 BY NEUTRON ACTIVATION USING A RADIUM-BERYLLIUM SOURCE. W. W. Beyer, J. N. Lewis, and G. L. Stukenbroeker. p.158-77 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECH-

NIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. 20p.

A neutron activation method for the determination of  $U^{235}$  in uranium materials is described. Thermal neutrons from a 2.5-g radium-beryllium source are used to irradiate the uranium samples. A sample of 500 mg of  $U_3O_8$ , packed in a cylindrical plastic vial, was chosen as the most suitable sample size and chemical form for routine neutron irradiation. The principles involved in the assay, the factors influencing the accuracy and precision of the isotopic analysis, the method of processing the uranium samples, and processing time for an assay are given. The use of an automatic sample irradiator has resulted in an improvement in the precision of the assay. The precision is now of the order of 0.6 per cent at the 95 per cent confidence level. "Pure"  $U_3O_8$  samples may be assayed at the rate of 10 vials per hour. (auth)

**14257** TID-7568(Pt. 2)(p.178-83)

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. HOT LABORATORY PROCEDURES USED IN BURNUP ANALYSES AT BETTIS PLANT. Alfred J. Moses.

p.178-83 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. 6p.

Highly radioactive fuel specimens which contain uranium are dissolved and processed in a shielded gamma box or a hot cell, depending on their activity level. Uranium is determined by isotope dilution after the addition of a known quantity of  $U^{233}$ . The necessary dilutions prior to fission-product analysis are performed in the gamma box or hot cell. Possible uranium and fission-product contamination of equipment and reagents is monitored by processing a nonirradiated uranium-containing control material. This is done after the cell work has been completed on the burnup specimens. (auth)

**14258** TID-7568(Pt. 2)(p.184-91)

Naval Postgraduate School, Monterey, Calif.

ESTIMATION OF BORON IN GRAPHITE BY REACTIVITY CHANGE. J. J. Branson, G. E. Jessen, J. R. Clark, and W. W. Hawes. p.184-91 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. 8p.

The boron content of several low-boron graphites has been estimated by measurement of the change in reactivity resulting from the introduction of the material into a small reactor. Adjusted to a small excess reactivity and at low neutron flux, samples were positioned centrally in the assembly and the period was determined for a flux multiplication of 4.5. An accurate comparison of the influence of the various samples was obtained. Independent determination of the influence of boron was made, utilizing dilute  $H_3BO_3$  solutions. Absolute boron concentrations were computed from best values of absorption cross sections. Concentrations of 0.8 to 2.6 ppm were found with uncertainties of the order of 0.2 ppm. (auth)

**14259** TID-7568(Pt. 2)(p.192-7)

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. RADIOCHEMICAL AND MASS SPECTROMETRIC



**STUDIES OF FISSION PRODUCT CESIUM.** A[lfred] J. Moses and H. D. Cook. p.192-7 [of] **ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS.** Second Conference, Gatlinburg, Tennessee, September 29–October 1, 1958. 6p.

The accuracy of fission determinations by  $\text{Cs}^{137}$  analyses depends in part on a knowledge of the half-life of this isotope. In this work, the half-life of  $\text{Cs}^{137}$  was re-determined by isotope dilution and 4- $\pi$  beta counting. The resultant value is  $28.6^{+2}_{-1}$  years. A method was developed to purify carrier-free, fission-product cesium by an ion-exchange separation. The isotopic composition of the purified cesium and the total cesium content were determined by mass spectrometric methods. The number of  $\text{Cs}^{137}$  atoms thus obtained was compared with data obtained by conventional radiochemical methods. (auth)

**14260** TID-7568(Pt. 2)(p.198-205)

Knolls Atomic Power Lab., Schenectady, N. Y. **THE APPLICATION OF ANION-EXCHANGE SEPARATIONS AND GAMMA SPECTROMETRY TO RADIO-CHEMICAL DETERMINATIONS OF ACTIVATED CORROSION PRODUCTS.** D[ragomir] Dutina and W. C. Judd. p.198-205 [of] **ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS.** Second Conference, Gatlinburg, Tennessee, September 29–October 1, 1958. 8p.

The buildup of activated corrosion products (crud) in coolant systems of water-cooled reactors has long been noted and has been a source of concern in considering the accessibility aspects of nuclear power plant operation. Corrosion products may be activated either during uninterrupted passage through the flux zone or after deposition on fuel elements. Redistribution of this radioactive deposited material to sections of the system which are intended to remain nonradioactive creates a radiological hazard during maintenance operations. In order to attempt to understand the mechanisms involved in crud formation, deposition, and redistribution, samples from in-pile loops operating at the MTR have been analyzed for  $\text{Fe}^{59}$ ,  $\text{Co}^{60}$ ,  $\text{Co}^{58}$ ,  $\text{Cr}^{51}$ ,  $\text{Mn}^{54}$ , and  $\text{Zr}^{95}$ - $\text{Nb}^{95}$ . These nuclides contribute the large majority of the gamma activity at the time of analysis, which is about two to three weeks after sampling. Methods are described for separating the various nuclides by means of anion-exchange techniques and for determining their disintegration rates by use of a 256-channel gamma spectrometer. By the application of these methods, one operator can analyze a moderately large number of samples with moderate precision. An operator analyzing six samples in parallel can determine the six listed nuclides in one sample per day. The coefficient of variation of these methods is of the order of 10%. (auth)

**14261** TID-7568(Pt. 2)(p.206-13)

Knolls Atomic Power Lab., Schenectady, N. Y. **SPECIFIC ACTIVITY DETERMINATION OF COBALT-60 IN NEUTRON-ACTIVATED CORROSION PRODUCTS.** Dragomir Dutina and W. C. Judd. p.206-13 [of] **ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS.** Second Conference, Gatlinburg, Tennessee, September 29–October 1, 1958. 8p.

During the operation of pressurized water reactors, corrosion products are released to the coolant stream,

activated, and redeposited on various components of the system, thus creating potential reactor habitability and accessibility problems. Cobalt-60 is a major contributor to the accessibility problem. The sources of the cobalt being activated and the relative contribution of the cobalt from different sources to the activity have not been established. The specific activity level of the cobalt in the corrosion product mixture can be related to its effective residence time in the flux. Such information may be useful in identifying the most important sources of cobalt-60. This paper describes a method for the determination of the specific activity of cobalt in corrosion product mixtures. It entails an anion-exchange separation of cobalt from elements which may interfere either with the radiochemical or colorimetric determinations of cobalt which follow. The disintegration rate of cobalt-60 in the separated fraction is determined by means of a 256-channel gamma spectrometer. The mass of the cobalt in the same fraction is determined by the nitroso-R colorimetric method. The method is applicable to corrosion samples as small as 10 mg which contain cobalt in concentrations as low as 0.01 percent. The coefficient of variation is of the order of 8 percent. (auth)

**14262** TID-7568(Pt. 2)(p.214-29)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

**DETERMINATION OF RADIOACTIVE RARE EARTHS IN REACTOR EFFLUENT WATER.** L. J. Kirby, W. B. Silker, and R. W. Perkins. p.214-29 [of] **ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS.** Second Conference, Gatlinburg, Tennessee, September 29–October 1, 1958. 16p.

Uncertainties in the suggested radioisotope MPC's for drinking water have placed increasing emphasis on the determination of individual radioactive species disposed to the Columbia River from reactor effluent water. These measurements are used to calculate radiation exposures resulting from downstream use of the river. In view of the wide range of the MPC's of rare-earth radioisotopes, it was essential to measure the concentrations of these radioisotopes in reactor effluent water. The rare-earth radioisotopes are formed in reactor effluent water by fission and by neutron activation of stable rare-earth isotopes. The main sources of these isotopes are impurities in the cooling water, with, perhaps, some resulting from corrosion within the reactor. A possible mechanism of formation incorporates film formation within the reactor tubes. Uranium and other impurities are retained on the tube walls for a finite time, and the fission products and activation products subsequently are released to the water. The rare-earth radioisotopes are separated from reactor effluent water and fractionated by ion-exchange chromatography. The activities of Y, La, Ce, Pr, Nd, Pm, Sm, and Eu are determined individually. Tentative identification was made of the presence of minor amounts of Ho, Er, Yb, and Lu activities. Analysis of the rare-earth fractions is made by beta proportional counting and by gamma scintillation counting. A method for the gamma-ray spectrometric measurement of  $\text{La}^{140}$ ,  $\text{Ce}^{141,143}$ ,  $\text{Sm}^{153}$ , and  $\text{Eu}^{152}$  without fractionation of the rare-earth group is also presented. (auth)

**14263** TID-7568(Pt. 2)(p.230-3)

Robert A. Taft Sanitary Engineering Center, Cincinnati. **RADIOCHEMICAL ANALYSES FOR PER[PRE]OPERA-**

TIONAL SURVEILLANCE. A. S. Goldin and C. P. Straub. p.230-3 [of] ANALYTICAL CHEMISTRY IN NUCLEAR REACTOR TECHNOLOGY. PART 2. INSTRUMENTATION, REMOTE CONTROL TECHNIQUES, AND NUCLEONICS. Second Conference, Gatlinburg, Tennessee, September 29-October 1, 1958. 4p.

Information on levels of radioactivity and their normal fluctuations in various environmental media, such as air, water, soil, vegetation, animals, bottom muds and silts, biological flora and fauna, milk and food substances, is necessary, prior to the operation of any nuclear energy facility, to permit determination and evaluation of the effect of the proposed facility on the environment. Radiation is contributed from a variety of sources, including fallout from weapons-test operations; spent radionuclides from beneficial applications of radioactive materials in research, industry, and medicine; radioactivity released from other atomic energy installations, as, for example, air particulates or liquid wastes discharged at some upwind or upstream location; natural radioactivity. The discussion indicates the preoperational tests required for different types of installations in relation to site location and specific function of the establishment. (auth)

**14264 UCRL-8615**

California. Univ., Berkeley. Lawrence Radiation Lab. THE DISCOVERY OF THE TRANSURANIUM ELEMENTS: THEIR HISTORY AND A PRESENTATION OF THE DIFFERENT METHODS USED IN THEIR DISCOVERY. Stanley G. Thompson. Apr. 1959. 23p. Contract W-7405-eng-48. \$4.80(ph), \$2.70(mf) OTS.

The ten transuranium elements discovered since 1940 are discussed in chronological order. The discoverer, the history, and methods used are given for each element. Future developments in the discovery and preparation of transuranic elements are discussed. (A.C.)

**14265 UCRL-8719**

California. Univ., Berkeley. Lawrence Radiation Lab. INDIRECT ACTION OF IONIZING RADIATION ON SOME ORGANIC COMPOUNDS CONTAINING THE C-N BOND. Warren M. Garrison. Apr. 1959. 21p. Contract W-7405-eng-48. \$4.80(ph), \$2.70(mf) OTS.

Observations on the indirect action of ionizing radiation on compounds containing primary amine, secondary amine, N-alkylamide, and peptide-bond configurations are correlated in terms of related mechanisms involving the C-N linkage as the locus of chemical change. The radiation chemistry of aqueous solutions of various amino acids and proteins is considered in detail from this viewpoint. Effects of oxygen and other solutes are discussed. Particular reference is given to: (a) studies of the radiation-induced oxidation of protein in oxygenated solution, (b) studies of radical-radical reaction in oxygen-free protein solutions containing a simple  $C^{14}$ -labeled organic solute such as  $CH_3C^{14}OOH$ . (auth)

**14266 UCRL-8736**

California. Univ., Berkeley. Lawrence Radiation Lab. FREE ENERGY FUNCTIONS FOR SOME  $MO_2$  OXIDES. M. S. Chandrasekharaiah and L. Brewer. Apr. 1959. 6p. Contract W-7405-eng-48. \$0.50(OTS).

The free energy functions for nine transition metal dioxides have been estimated by considering them as linear symmetrical molecules. (auth)

**14267 UCRL-8755**

California. Univ., Berkeley. Lawrence Radiation Lab. ADSORPTION OF XENON IN AN ACTIVATED CHAR-

COAL COLUMN. H. P. Cantelow. May 11, 1959. 29p. Contract W-7405-eng-48. \$4.80(ph), \$2.70(mf) OTS.

Performance characteristics of two activated charcoal columns at room temperature in separating fission-product xenon from an air stream were investigated by installing each column in the exhaust from an enclosure in which irradiated slugs were dissolved. Breakthrough curves are presented and the variation in xenon concentration within the columns is examined. Theoretical treatments of adsorption columns in the literature are found to agree well with the experimental data. Performance of the columns is evaluated in terms of "concentration factor" and number of effective theoretical plates. (auth)

**14268 WADC-TN-57-298(Pt. I)**

Advisory Committee for Nuclear Measurements and Standards (ANP).

PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. (Part I, Unclassified Papers.) Robert E. Brocklehurst. Feb. 1959. 229p. Project title: NUCLEAR INSTRUMENTATION SUBSYSTEMS. Task title: NUCLEAR INSTRUMENTATION. (AD-142342; PB-131773). \$3.50(OTS).

Seventeen papers are presented in this volume. The subjects covered in these proceedings are instrumentation for gamma and neutron spectral measurements, treatment of experimental data, characteristics of scintillation crystals, and the use of beam collimators. Separate abstracts have been prepared for each paper. (W.L.H.)

**14269 WADC-TN-57-298(Pt. I)(p.1-10)**

Convair, Fort Worth, Tex.

SPECTROSCOPY REQUIREMENTS FOR ANP ACTIVATION PROGRAM. W. E. Dungan. p.1-10 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 10p.

An outline is presented of the requirements for neutron and gamma spectroscopy in support of the ANP activation program. (W.L.H.)

**14270 WADC-TN-57-298(Pt. I)(p.11-22)**

General Electric Co. Aircraft Nuclear Propulsion Dept., Evendale, Ohio.

SPECTROSCOPY REQUIREMENTS FOR ANP RADIATION DAMAGE PROGRAM. James B. Trice. p.11-22 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 12p.

Radiation testing of various materials including organics, liquids, metals, and ceramics is reviewed in order to point out specific monitoring requirements. The problems of dosimetry and spectroscopy associated with metals are intimately examined inasmuch as such tests appear to pose the greatest challenge to the reactor engineer. Methods available for measuring both the neutron field about the metal and the neutron dose to the metal are reviewed. Examination of the purposes of radiation testing reveals that the neutron spectroscopy requirements for radiation damage tests are as varied as the purposes for which the tests are performed. (auth)

**14271 WADC-TN-57-298(Pt. I)(p.23-30)**

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

STANDARDIZATION OF TECHNIQUES IN THE USE OF SCINTILLATION SPECTROMETRY FOR ROUTINE ANALYSIS. R. L. Heath. p.23-30 [of] PROCEEDINGS



OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 8p.

The problem of applying the techniques of gamma-ray scintillation spectrometry to routine problems in radioactivity measurement is presented. It would appear that the utilization of the possibilities of these methods has been hampered by a lack of published information on the response of the detectors to monoenergetic radiation and the methods of data analysis. To permit the use of these techniques in the routine laboratory, it has been necessary to standardize the measurement techniques. The factors which influence the precision of measurements are discussed in some detail. These include the choice of detector, radiation shield design, source-detector geometry, and methods of data processing. (auth)

**14272** WADC-TN-57-298(Pt. I)(p.31-40)

Naval Research Lab., Washington, D. C.

THE NaI SUMMING SPECTROMETER. P. Shapiro, R. W. Higgs, and L. A. Beach. p.31-40 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 10p.

Determination of the photopeak efficiency of the NaI summing spectrometer and analysis of the pulse height distributions obtained are discussed. (auth)

**14273** WADC-TN-57-298(Pt. I)(p.41-52)

Naval Research Lab., Washington, D. C.

A STUDY OF PHOTONS IN NaI(Tl) SCINTILLATION COUNTERS. L. A. Beach and C. M. Davisson. p.41-52 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 12p.

With the aid of the digital computer, a Monte Carlo study has been made of the scattering, absorption, and emergence of 0.1 to 1.5 Mev protons in NaI(Tl) crystals ranging in size from one inch diameter by one inch length to five inch diameter by eight inch length. (W.L.H.)

**14274** WADC-TN-57-298(Pt. I)(p.53-78)

Naval Radiological Defense Lab., San Francisco.

COLLIMATOR PENETRATION AND SCATTERING EFFECTS. W. E. Kreger, R. L. Mather, and R. A. Hefnerlin. p.53-78 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 26p.

Theoretical and experimental results are shown which describe the behavior of collimator systems for gamma radiation. The type of lead collimator used for gamma rays of about 1 Mev and below has been found essentially free from scattering; hence the effective collimator aperture to gamma radiation in certain source-collimator geometries can be calculated according to the theory by Mather, which covers the penetration of the collimator material by radiation. (auth)

**14275** WADC-TN-57-298(Pt. I)(p.78-96)

National Bureau of Standards, Washington, D. C.

GAMMA-RAY ENERGY AND ANGULAR DISTRIBUTIONS IN CONNECTION WITH PENETRATION THROUGH THICK BARRIERS, PARTICULARLY LEAD. John H. Hubbell and L. V. Spencer. p.78-96 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 19p.

Qualitative features of gamma-ray spectra and angular distributions at deep penetrations are discussed,

based on results of moments method and Monte Carlo calculations. Also, some aspects of spectroscopy as applied to verification of deep-penetration theory are brought out in the presentation of a lead-penetration experiment. (auth)

**14276** WADC-TN-57-298(Pt. I)(p.97-126)

Oak Ridge National Lab., Tenn.

TOTAL ABSORPTION GAMMA RAY SPECTROSCOPY. G. T. Chapman and N. H. Lazar. p.97-126 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 30p.

A review of the pulse height distribution curves obtained at ORNL with large sodium iodide crystals is presented. A comparison of such distributions obtained with  $9\frac{3}{4}$  inch diam  $\times$  9 inch deep crystals is made with those resulting from 3 inch diam by 3 inch long "standard crystals" over an energy range from 0.662 Mev to 7 Mev. A discussion is given of the observed effects with the gamma rays introduced externally and internally into the crystal. A comparison of collimated and uncollimated gamma rays is made. The measured peak to total ratios for the  $9\frac{3}{4}$  inch crystals is presented and compared to the same ratios obtained for multi-crystal spectrometers. (auth)

**14277** WADC-TN-57-298(Pt. I)(p.127-36)

Pennsylvania, Univ., Philadelphia.

APPLICATION OF DATA REDUCTION METHODS USED IN PHOTONUCLEAR PHYSICS TO THE SPECTROMETER RESOLUTION PROBLEM. B. C. Cook. p.127-36 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 10p.

The methods that have been developed for obtaining photon absorption cross section from photoexcitation curves are reviewed. Possible applications of the spectrum transformation method to the spectrometer resolution problem are discussed. (auth)

**14278** WADC-TN-57-298(Pt. I)(p.137-50)

Naval Radiological Defense Lab., San Francisco.

PULSE HEIGHT TO SPECTRUM DATA REDUCTION IN LOW ENERGY GAMMA SCINTILLATION SPECTROMETRY. N. Scofield. p.137-50 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 14p.

Some of the pertinent features of the detection of gamma rays by NaI(Tl) scintillation spectrometers are discussed. Methods of determining and representing the response function are presented, including some corrections to the raw spectra. Finally, an example of unfolding is shown comparing the stripping and inverse matrix multiplication processes. (auth)

**14279** WADC-TN-57-298(Pt. I)(p.151-71)

Oak Ridge National Lab., Tenn.

METHODS OF FAST-NEUTRON SPECTROSCOPY. R. B. Murray. p.151-71 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 21p.

A review of techniques suitable for neutron spectroscopy in the region 1 to 12 Mev is presented with emphasis on methods applicable to the problems associated with ANP shielding. The requirements demanded of a neutron spectrometer for shielding studies are listed, and current techniques are discussed in view of these requirements. The recent use of  $\text{Li}^6\text{I}(\text{Eu})$  as a single

crystal scintillation spectrometer for fast neutrons is discussed. (auth)

**14280** WADC-TN-57-298(Pt. 1)(p.172-82)

Airborne Instruments Lab., Inc., Mineola, N. Y. AUTOMATIC MEASUREMENT OF NEUTRON SPECTROMETER PLATES. Karl C. Speh. p.172-82 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 11p.

Recent developments in automatic track counters for nuclear emulsions are described. Several instruments have succeeded in reliably distinguishing and counting tracks in the emulsion background, but none is yet capable of automatic track length measurement. Two stages of further development are discussed. One requires the design of scattering-camera experiments especially for automatic analysis; the other comprises design studies for an instrument capable of analyzing most types of neutron spectrometer plate. (auth)

**14281** WADC-TN-57-298(Pt. 1)(p.183-8)

Oak Ridge National Lab., Tenn.

REACTOR NEUTRON SPECTRAL MEASUREMENT DIFFICULTIES. K. M. Henry. p.183-8 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 6p.

The proton recoil-neutron spectrometer as used at the Bulk Shielding Facility of ORNL is inherently an instrument possessing limited energy resolution, low sensitivity and poor background rejection. The interaction of errors and limitations of the instrument are discussed. (auth)

**14282** WADC-TN-57-298(Pt. 1)(p.189-95)

Oak Ridge National Lab., Tenn.

BULK SHIELDING FACILITY METHODS OF SPECTRUM UNSCRAMBLING. W. Zobel and G. M. Estabrook. p.189-95 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 7p.

A description is given of the proposed method for reduction of gamma-ray spectroscopic data obtained by the Oak Ridge National Laboratory's Bulk Shielding Facility Spectroscopy Group. The results obtained in the effort to attain a satisfactory method for "spectrum unscrambling" are also described. (auth)

**14283** WADC-TN-57-298(Pt. 1)(p.196-206)

Argonne National Lab., Lemont, Ill.

EXPERIMENTAL APPLICATIONS OF SHIELDING AND COLLIMATING TO NEUTRONS FROM SOURCES EMPLOYING THE ELECTROSTATIC GENERATOR. Alexander Langsdorf, Jr. p.196-206 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 11p.

Some aspects of the design and behavior of shielding and collimation employed with experimental neutron detectors are discussed. The neutron source is the small spot, nearly a point source, at which the beam from an electrostatic generator strikes the target. (auth)

**14284** WADC-TN-57-298(Pt. 1)(p.207-13)

Aerojet-General Nucleonics, San Ramon, Calif.

DEVELOPMENT OF THRESHOLD FOILS FOR NEUTRON SPECTRA DETERMINATIONS. R. L. Newacheck and J. D. Randall. p.207-13 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD

AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 7p.

Techniques are described that will be used to develop and standardize a series of neutron sensitive foils which may be used to obtain approximate neutron spectra for radiation damage studies. A method of calibrating the foils with a low flux research reactor is discussed. Tentative designs are presented for  $U^{238}$ ,  $S^{32}$ , and boron covered  $Pu^{239}$  threshold foils which will be used to measure fast neutron spectra. Thermal neutron sensitive foils, both bare and cadmium covered are described. The instrumentation required to obtain data from the foils is presented, together with the neutron intensities that may be explored with these detectors. (auth)

**14285** WADC-TN-57-298(Pt. 1)(p.214-23)

Los Alamos Scientific Lab., N. Mex.

$P^{31}(n,p)Si^{31}$  AND  $Al^{27}(n,\alpha)Na^{24}$  CROSS SECTIONS. J. A. Grundl, R. L. Henkel, and B. L. Perkins. p.214-23 [of] PROCEEDINGS OF THE ANP SPECTROSCOPY INFORMATION MEETING HELD AUGUST 6-7, 1957 AT WRIGHT AIR DEVELOPMENT CENTER. 10p.

Previously abstracted in NSA 12-5690.

**14286** WADC-TR-55-30(Pt. 7)

Pennsylvania State Univ., University Park. Petroleum Refining Lab.

FLUIDS, LUBRICANTS, FUELS AND RELATED MATERIALS. Period Covered: January through December 1958. E. Erwin Klaus and Merrell R. Fenske. Feb. 1, 1959. 247p. Project Nos. 3044 and 1428. Contract AF33(616)-5460.

This report describes work carried out on a continuing program to characterize the behavior of various base stocks and fluid formulations for application as hydraulic fluids and/or jet engine lubricants in the temperature range of 350 to 700°F. Esters, mineral oils, and hydrocarbons are evaluated for use as base stocks. The use of selected structures is shown to result in improvement in thermal stability and/or low temperature properties for esters and polyolefins. For mineral oils and hydrocarbons, the emphasis is on the achievement of improved additive response by super-refining, optimum viscosity-volatility properties by close cut fractionation, and improved viscosity-low temperature relationships by deep dewaxing. Oxidation tests of bulk oil, thin film, deposition, and successive (contamination) types are critically compared and contrasted for a series of super-refined and conventional mineral oils containing various additive packages. The additive package ranges from a single additive to an integrated package designed to control oxidation, corrosion, dirtiness, foaming, lubricity, low temperature fluidity, and viscosity level. Four low molecular weight, shear stable polymeric thickeners have been evaluated and compared with the conventional polymeric thickeners. Two of these materials provide multifunctionality as dispersants and pour depressants as well as thickeners. Used jet engine oils (silicones, mineral oils, and esters), from J-57 engines run at 300 and 350°F oil-in have been evaluated for changes in physical and overall stability properties. Quantitative analysis of the used samples for oxygenated groupings provides an estimate of the extent of oxidative deterioration. The degree of oxidation of the used engine oils is compared with the severity of various types of specification and laboratory tests. A modification of an experimental high temperature hydraulic fluid which would offer rust protection is proposed for evaluation as a missile hy-



draulic fluid. Fuel dilution has been explored as a method to improve low temperature fluidity of mineral oils. (See also PRL-214.) (auth)

**14287** AEC-tr-3662

THE REACTIONS OF 2,2', 4,4', 6,6'-HEXANITRODIPHENYLAMINE (DIPICRYLAMINE) WITH Cs, Rb, K, AND  $\text{NH}_4$ . Vaclav Kourim, Josef Krtil, and Ctirad Konecny. Translated for Los Alamos Scientific Lab. from *Chem. listy* 52, 262-8(1958). 8p. \$1.80(ph), \$1.80(mf) JCL.

A study was made of the precipitation of alkali elements, and particularly of cesium, using dipicrylamine, and a procedure suggested for quantitative determination of cesium using gravimetric and colorimetric methods. The colorimetric method was used to determine the solubility of the dipicrylamines of Rb, K, and  $\text{NH}_4$  in water and in diethyl ether, and the absorption spectra in the ultraviolet and visible bands were used to illustrate the behavior and structure of these compounds. (auth)

**14288** AEC-tr-3667

STUDIES OF THE CATHODIC PROCESS DURING ELECTROLYSIS OF THE PURE MOLTEN CHLORIDES OF CALCIUM, SODIUM AND POTASSIUM. L. Suskii. Translated by A. L. Monks (Oak Ridge National Lab.) from *Zhur. Fiz. Khim.* 32, 1393-1403(1958). 28p. (Includes original, 11p.) \$4.80(ph), \$2.70(mf) JCL or LC.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 16212.

**14289** AEC-tr-3705

DEVELOPMENT OF CHEMICAL STUDIES AT SUPER-HIGH COMPRESSIONS. M. G. Gonikberg. Translated by A. L. Monks (Oak Ridge National Lab.) from *Vestnik Akad. Nauk S.S.S.R.* 27, No. 2, 50-8(1957). 16p. \$3.30(ph), \$2.40(mf) JCL or LC.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 11, as abstract No. 7106.

**14290**

STUDIES ON THE HYDROLYSIS OF METAL IONS. 22. EQUILIBRIUM STUDIES IN SELF-MEDIUM; APPLICATION TO THE HYDROLYSIS OF  $\text{Th}^{4+}$ . Sirikka Hietanen and Lars Gunnar Sillen (Royal Inst. of Tech., Stockholm). *Acta Chem. Scand.* 13, 533-50(1959).

It is suggested that added information on polynuclear complexes,  $\text{A}_p\text{B}_q$ , between the reagents A and B, may be obtained by working with an ionic medium where one of the reagents, say B, forms the major part of the ions of one charge. This is termed the "self-medium method," as distinguished from the "inert medium method," e.g., with  $\text{NaClO}_4$ , in current use. The self-medium method favors complexes  $\text{A}_p\text{B}_q$  with low values for p/q so that information may be obtained about such complexes with a greater certainty than from work with inert media. The self-medium method has been applied to the hydrolysis of  $\text{Th}^{4+}$ . The data indicate the two reactions  $2\text{Th}^{4+} + 2\text{H}_2\text{O} \rightleftharpoons \text{Th}_2(\text{OH})_2^{6+} + 2\text{H}^+$  (equil. const.  $\beta_{22}$ ) and  $2\text{Th}^{4+} + \text{H}_2\text{O} \rightleftharpoons \text{Th}_2\text{OH}^{7+} + \text{H}^+$  ( $\beta_{12}$ ). In the medium 0.5 Th, 2.2 (Na)Cl,  $\log \beta_{22} = -5.02 \pm 0.04$ ,  $\log \beta_{12} = -2.8 \pm 0.2$ . In 0.7 Th, 3.0 (Na)Cl,  $\log \beta_{22} = -5.09 \pm 0.04$ ,  $\log \beta_{12} = -2.9 \pm 0.2$ . Temperature 25°C. (auth)

**14291**

TITRIMETRIC DETERMINATION OF HYDROGEN PRESENT AS WATER AND/OR HYDROGEN FLUORIDE

IN URANIUM TETRAFLUORIDE AND MAGNESIUM FLUORIDE. Warren M. Wise (Mallinckrodt Chemical Works, St. Charles, Mo.). *Anal. Chem.* 31, 1001-3(1959) June.

A method is described for determining concentrations of hydrogen of about 35 ppm present as water and/or hydrogen fluoride in uranium tetrafluoride and refractory magnesium fluoride. The sample is ignited in a furnace to volatilize the desired constituents into a stream of dry nitrogen. The gases are passed over hot sodium carbonate, and the hydrogen fluoride reacts to form water. The water vapor is bubbled through a known excess of Karl Fischer reagent. The excess reagent at the end of the run is titrated with a methanol solution containing a known concentration of water. At the 95% confidence level the relative precision is to  $\pm 13\%$  for uranium tetrafluoride and  $\pm 16\%$  for magnesium fluoride samples. With respect to recovery of water, the method has no significant bias at the 95% confidence level. (auth)

**14292**

DETERMINATION OF IRON, CHROMIUM, AND NICKEL BY FLUORESCENT X-RAY ANALYSIS. AQUEOUS SOLUTION METHOD. William W. Houk and Louis Silverman (Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.). *Anal. Chem.* 31, 1069-72(1959) June.

The iron, chromium, and nickel contents in many types of stainless steels and nickel-chromium alloys were determined by fluorescent x-ray analysis. The samples were dissolved in aqua regia and hydrofluoric acids, fumed with perchloric acid, and diluted to volume with water. The fluorescence data were obtained for specific  $K\alpha$  lines and background. The ratio of the intensity of the element plus background to the intensity of the background was compared to a standard plot to obtain the percentage of element present. These values were within 3% of the recommended values of the National Bureau of Standards samples when a Geiger counter was used, and within 1.5% when a scintillation counter was used to measure the intensities of the fluorescent radiation. The addition of the pulse height discrimination unit to the scintillation counter reduced the lower limit of detection for iron, chromium, and nickel to 5 to 10  $\gamma$  per ml. of sample. The standard curves plotted for the stainless steel alloys were equally applicable to chromium-nickel alloys. (auth)

**14293**

SEPARATION OF RADIUM AND BARIUM BY ION EXCHANGE ELUTION. W. H. Power, H. W. Kirby, W. C. McCluggage, G. D. Nelson, and J. H. Payne, Jr. (Mound Lab., Miamisburg, Ohio). *Anal. Chem.* 31, 1077-9(1959) June.

Radium can be separated from barium-radium mixtures in ratios as high as 4440 to 1 by a single elution from a cation exchange resin. Barium elution characteristics from Dowex 50 resin, position of elution maxima, and maximum barium loadings are correlated with citrate concentration and pH by the use of citrate complex equilibria. Ammonium citrate, 0.32M at pH 5.6, is the most satisfactory eluent of those used from the standpoints of separation factor and freedom from precipitation in the column. Conditions affecting the precipitation of slightly soluble barium citrate during elution with ammonium citrate are discussed. Eluting above 25°C decreases separation factors and permissible barium levels. (auth)

**14294****RADIOCHEMICAL DETERMINATION OF URANIUM-237.**

F. L. Moore and S. A. Reynolds (Oak Ridge National Lab., Tenn.). *Anal. Chem.* **31**, 1080-1(1959) June.

A radiochemical method for the determination of uranium-237 is based on complexing the uranyl ion in alkaline solution with hydroxylamine hydrochloride, followed by scavenging with zirconium hydroxide and extraction of the uranium from hydrochloric acid solution with tri(iso-octyl)amine-xylene. The technique has been applied successfully to the determination of uranium-237 in homogeneous reactor fuel solutions. (auth)

**14295****DETERMINATION OF URANIUM AND BERYLLIUM IN FUSED FLUORIDE SYSTEMS.** N. E. Rogers and W. D. Prather (Mound Lab., Miamisburg, Ohio). *Anal. Chem.* **31**, 1081-4(1959) June.

A method is described for the quantitative separation and determination of uranium and beryllium in the presence of macro quantities of sodium in a ternary system of fused fluorides. The fluoride ion is volatilized as fluoboric acid during the dissolution of the dried, mixed salts with acids. Sexivalent uranium is separated from beryllium and sodium by the electrolytic deposition of the uranium as a hydrous oxide on a platinum electrode from a hot ammonium acetate solution at pH 4.0. The beryllium remains in the plating solution with the sodium, and is determined as the hydroxide. Both the uranium deposit and the beryllium hydroxide precipitate are ignited and weighed as their oxides. Sodium is determined by flame photometer or calculated as the difference between the combined weights of the uranium and beryllium fluorides and the original sample weight. (auth)

**14296****DETERMINATION OF BROMINE IN URANIUM FLUORIDES AND OXIDES.** Robert P. Larsen and Nathan M. Ingber (Argonne National Lab., Lemont, Ill.). *Anal. Chem.* **31**, 1084-6(1959) June.

A procedure for the determination of  $10^{-5}\%$  bromine in uranium fluorides and oxides is described. Preliminary separation from gross impurities is made by distilling elemental bromine from a mixture of chromic and sulfuric acids; and final separation is made by extracting with carbon tetrachloride. Bromine is determined spectrophotometrically after bromination of the dye, phenol red. For an optimum sample the coefficient of variation is 5. (auth)

**14297****CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF EUROPIUM.** W. D. Shults (Oak Ridge National Lab., Tenn.). *Anal. Chem.* **31**, 1095-8(1959) June.

The europium content of europium oxide can be precisely determined by controlled-potential coulometry. The electrolytic reduction of europic ions was not satisfactory for direct quantitative titration but was for the preparation of europous ions. Immediate coulometric reoxidation of the europous ions thus produced is the means of quantitative estimation. The method is reasonably rapid and is free from interference from the usual contaminants. (auth)

**14298****COLORIMETRIC DETERMINATION OF BORON WITH VICTORIA VIOLET.** Charles A. Reynolds (Univ. of Kansas, Lawrence). *Anal. Chem.* **31**, 1102-4(1959) June.

In the pH range of 7.7 to 10.0 the absorbance of the dye, Victoria Violet, is markedly lowered by the presence of boric acid. A simple colorimetric method for boron in the range of 0.02 to 0.60 mg. of boron has been developed based on this decrease in absorbance. Measurements were made at 540 m $\mu$  on solutions adjusted to pH 8.75. (auth)

**14299****DETERMINATION OF OXYGEN, HYDROGEN, AND NITROGEN IN REFRACTORY METALS.** J. E. Fagel, R. F. Witbeck, and H. A. Smith (General Electric Co., Cleveland). *Anal. Chem.* **31**, 1115-16(1959) June.

The reliability of the results obtained by vacuum extraction and the applicability of the technique to refractory metals are presented. The advantages of vacuum extraction relative to conventional iron bath vacuum fusion analysis are given. (J.E.D.)

**14300****THE SEPARATION OF BERYLLIUM FROM POLYVALENT CATIONS WITH A DIALLYL PHOSPHATE COMPLEXING RESIN.** J. Kennedy and V. J. Wheeler (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Anal. Chim. Acta* **20**, 412-15(1959) May.

The complexing polymer sodium diallyl phosphate (NaDAP) when used in conjunction with disodium ethylene diamine tetraacetate ( $\text{Na}_2\text{EDTA}$ ) separates beryllium quantitatively from alkaline earths (Ca and Sr), ferric and divalent cations of the first transitional period, aluminum and lanthanides, cadmium, mercury(II), bismuth, and polonium(IV). The high affinity of NaDAP for beryllium should permit its concentration by several orders of magnitude, when present as a minor or trace component in a mixture of polyvalent cations. The results are compared with those obtained using sulfonated resin. (auth)

**14301****SOLUBILITY PRODUCT RELATIONS IN THE RARE EARTH HYDROUS HYDROXIDES.** Clifford C. Meloeche and Frederick Vrátný (Univ. of Michigan, Ann Arbor). *Anal. Chim. Acta* **20**, 415-18(1959) May.

The solubility products for some rare earth hydroxides and their temperature dependence are reported. Greater solubility is shown for larger atomic radii and for lower temperature. (auth)

**14302****DETERMINATION OF URANIUM IN ZIRCON.** Frank Cuttitta and Grafton J. Daniels (U. S. Geological Survey, Washington, D. C.). *Anal. Chim. Acta* **20**, 430-4(1959) May.

A routine fluorimetric procedure is described for the determination of trace amounts of uranium in zircon. It employs the direct extraction of uranyl nitrate with ethyl acetate using phosphate as a retainer for zirconium. Submicrogram amounts of uranium are separated in the presence of 100,000 times the amount of zirconium. The modified procedure has been worked out using synthetic mixtures of known composition and zircon. Results of analyses have an accuracy of 97 to 98% of the contained uranium and a standard deviation of less than 2.5%. (auth)

**14303****A RAPID ROUTINE METHOD FOR THE DETERMINATION OF SUB-MICROGRAM AND MICROGRAM AMOUNTS OF BERYLLIUM IN FILTER PAPER.** T. M. Florence (Australian Atomic Energy Research Establishment, Lucas Heights, New South Wales). *Anal. Chim. Acta* **20**, 472-6(1959) May.



A rapid routine method for the determination of sub-microgram and microgram amounts of beryllium in filter paper smears is presented. Beryllium is determined fluorimetrically with 3,5,7,2',4'-pentahydroxyflavone (Morin). Many interfering elements are removed by adsorption on a strongly basic anion-exchange resin from 9N hydrochloric acid. (auth)

**14304**

THE RAMAN AND INFRARED SPECTRA OF CHLOROACETIC ACIDS. IV. THE DEUTERATED ACIDS. Clara Otero, José R. Barceló, and F. Gómez Herrera (Instituto de Optica "Daza de Valdes" and Instituto de Quimica "Alonso Barba," Madrid). *Anales real soc. españ. ffs. y quim.* (Madrid), Ser. B 55, 205-14(1959) Mar. (In Spanish)

The Raman and infrared spectra of the deuterated chloroacetic acids, in which the isotopic substitution is done on the carboxylic group, are studied. The spectra of those compounds are compared with those previously obtained with the light acids. With those data, the fundamental frequencies are assigned more firmly to the vibration modes. This assignation confirms in most cases the values previously given. (auth)

**14305**

DETERMINATION OF URANIUM BY FLUORESCENCE. I. DESIGN AND TESTING OF EQUIPMENT. R. Fernández Cellini, F. de la Cruz Castillo, and R. Barrera Piñero (Junta de Energia Nuclear, Madrid). *Anales real soc. españ. ffs. y quim.* (Madrid), Ser. B 55, 277-88(1959) Mar. (In Spanish)

A fluorimetric installation was developed for the determination of uranium at such low concentrations that it could not be determined by even the most sensitive analytical methods known. The new fluorimeter was adapted to measure the fluorescence emitted by the phosphor sodium fluoride-sodium carbonate-potassium carbonate-uranyl ion excited by ultraviolet light at 33,650 Å. The fluorimeter gives a linear response for uranium quantities between 0 and 15  $\gamma$  with a sensitivity of 0.001  $\gamma$  of U. The procedure was used successfully as a routine method for uranium determination in very low grade samples. (auth)

**14306**

THE DETERMINATION OF THORIUM IN ORES BY LIQUID-LIQUID EXTRACTION. D. A. Everest and J. V. Martin (National Chemical Lab., Teddington, Middx., Eng.). *Analyst* 84, 312-17(1959) May.

A rapid method is described for the determination of thorium in medium-grade ores. Thorium is separated from gross amounts of other elements by extraction from nitric acid to which aluminum nitrate has been added as a salting-out agent, with isobutyl methyl ketone containing 10% v/v of tri-n-butyl phosphate. The aqueous layer contains mesotartaric acid, which forms a complex with any zirconium present and prevents its extraction. Thorium is extracted from the organic phase with water and is finally determined absorptiometrically with 1-(o-arsonophenylazo)-2-naphthol-3:6-disulfonic acid. (auth)

**14307**

EXCHANGE CAPACITIES OF SOME SYDNEY SOILS FOR STRONTIUM IONS. B. R. Craven and J. H. Green (Univ. of New South Wales, Kensington, Australia). *Australian J. Appl. Sci.* 10, 104-12(1959) Mar.

A continuous-recording apparatus was used for the determination of the dynamic cation-exchange properties of soils. Selected cations mixed with a suitable

radioisotope in aqueous solutions are passed at a constant rate through a soil column and the effluent is monitored with a recording Geiger-Mueller counter. Results are given for the exchange of strontium, labeled with  $\text{Sr}^{89}$ , with six soils typical of the Sydney area. (auth)

**14308**

ON THE COUPLING BETWEEN  $\text{F}^{19}$  AND  $\text{H}^1$  NUCLEI IN p-FLUOROTOLUENE. T. Schaefer (Univ. of Manitoba, Winnipeg, Can.). *Can. J. Chem.* 37, 882-8(1959) May.

The proton and fluorine high resolution nuclear magnetic resonance spectra of p-fluorotoluene are discussed in terms of the case  $\text{A}_2\text{A}_2'\text{X}$ . The  $4 \times 4$  submatrices are diagonalized in analytical form and therefore explicit values for all energy levels can be obtained. The spectra are consistent with  $J_{\text{m}}^{\text{HF}} = J_0^{\text{HF}}$ , which may be of theoretical interest. (auth)

**14309**

THE EFFECT OF SULFATE ION ON THE CRYSTAL SIZE OF PRECIPITATED RARE EARTH OXALATES. A. Glasner, M. Steinberg, and E. Levy (Hebrew Univ., Jerusalem). *Chemist Analyst* 48, 37-8(1959) June.

In separating rare earths from other cations in the form of insoluble oxalates, it was found that well grown crystals were precipitated from solutions due to the effect of the sulfate ion. It is pointed out that the precipitate from  $\text{HNO}_3$  solution is a collection of aggregates of small crystals, while those obtained from the sulfuric acid solution are well grown with clearly discernible crystalline form. (J.R.D.)

**14310**

THE SELENIDES  $\text{MeSe}$  OF THE LANTHANIDES, FROM LANTHANUM TO GADOLINIUM. Micheline Guittard and André Benacerraf. *Compt. rend.* 248, 2589-91(1959) May 4. (In French)

The preparation and properties of the selenides of La, Ce, Pr, Nd, Sm, Eu, and Gd are described. All these selenides crystallize in the cubic system of the NaCl type. Their stability at high temperatures suggests their utilization as refractory materials. (tr-auth)

**14311**

THE DIFFERENT VARIETIES OF ZIRCONIUM TETRAFLUORIDE. André Chrétien and Bernard Gaudreau. *Compt. rend.* 248, 2878-9(1959) May 20. (In French)

The preparation and properties of two crystalline varieties and one amorphous variety of zirconium tetrafluoride are presented. (tr-auth)

**14312**

DIFFUSION IN CHROMIUM-NITROGEN SYSTEMS. V. I. Arkharov, V. N. Konev, and A. Z. Men'shikov (Gor'kii Ural State Univ., USSR). *Fiz. Metal. i Metalloved.* 7, 64-71(1959) Jan. (In Russian)

The kinetics, phase composition, texture of the nitride layers, and microstructure of chromium nitration in ammonia at 600 to 1200°C were investigated. (R.V.J.)

**14313**

ELECTROCONDUCTIVITY OF MANGANESE PHOSPHIDES. I. G. Fakidov and V. P. Krasovskii (Inst. of Metal Physics, Academy of Sciences, USSR). *Fiz. Metal. i Metalloved.* 7, 156-7(1959) Jan. (In Russian)

The electric conductivity temperature dependence of manganese alloys with 33 to 53 wt.% phosphorus was investigated. (R.V.J.)

**14314**

ON CERTAIN PROPERTIES OF CARBON THERMAL REDUCTION OF PENTAVALENT NIOBIUM OXIDE.

P. V. Gel'd and G. P. Shveikin. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo* No. 1, 44-9(1959) Jan.-Feb. (In Russian)

The reduction kinetics of  $\text{Nb}_2\text{O}_5$  was studied in order to develop an improved technological process for the direct preparation of Nb. The effects of structure in the low-temperature reduction were analyzed, and the phase composition at various temperatures (from 550 to 1200°C) was tabulated. The high-temperature reduction of niobium oxide was also analyzed, and it is shown that from the technical point of view the method using the carbide-oxide mixture is the most convenient for preparing metallic niobium. (R.V.J.)

#### 14315

THE EFFECT OF DEUTERIUM ON THE KINETICS OF REACTIONS INVOLVING NEPTUNIUM(IV), (V) AND (VI) IONS. J. C. Hindman, J. C. Sullivan, and Donald Cohen (Argonne National Lab., Lemont, Ill.). *J. Am. Chem. Soc.* **81**, 2316-19(1959) May 20.

The rate of neptunium(IV)-neptunium(VI) reaction is markedly decreased in both sulfate and perchlorate solutions by the addition of deuterium. The ratio of the observed rate constants for perchlorate solutions at 25° is  $k_{\text{H}}/k_{\text{D}} = 5.0$ . The similarity of the effect in both sulfate and perchlorate solutions lends support to the previous suggestions that the mechanism is the same in both media. The disproportionation rate of neptunium(V) in sulfate solution is increased by deuterium. The interpretation of the isotope effect in terms of possible pre-equilibria and reaction intermediates is discussed. (auth)

#### 14316

ISOTOPIC EXCHANGE REACTIONS IN LIQUID SULFUR DIOXIDE. V. THE ACID HALIDE-CATALYZED  $\text{S}^{35}$ -EXCHANGE BETWEEN THIONYL CHLORIDE AND SULFUR DIOXIDE. David E. Burge and T. H. Norris (Oregon State Coll., Corvallis). *J. Am. Chem. Soc.* **81**, 2324-9(1959) May 20.

A study has been made of the kinetics of catalysis by antimony pentachloride of the radiosulfur exchange reaction between thionyl chloride and liquid sulfur dioxide. The process is interpreted as a case of acid catalysis in contrast to the previously investigated basic chloride catalysis. Exchange rates are only about one-hundredth as large as in the basic catalysis. The indicated rate law is  $\text{rate} = k(\text{SO}_2)(\text{SOCl}_2\text{-SbCl}_5)$ , where the last term represents a complex formed in a rapid preliminary reaction with a formation equilibrium constant  $K \approx 0.8$  at 0°, and  $\Delta H^\circ \approx 3.6$  kcal./mole. The rate constant is given by  $k = 0.875 \times 10^2 \exp(-10,400/RT)$  l mole<sup>-1</sup> sec.<sup>-1</sup>. The entropy of activation is -51.6 e.u.  $K$  and  $k$  appear to be essentially unchanged throughout the complete solvent range from excess sulfur dioxide to excess thionyl chloride. An activated complex involving a double chlorine, oxygen bridge between sulfurs is postulated, reminiscent of that proposed for the basic chloride case. The greater complexity of the acid complex may account for the lower exchange rates observed. The occurrence of catalysis by aluminum chloride at a ten-fold lower rate is confirmed and briefly discussed. (auth)

#### 14317

ISOTOPIC EXCHANGE REACTIONS IN LIQUID SULFUR DIOXIDE. VI. MIXED ACIDIC AND BASIC CATALYSTS AND THE  $\text{S}^{35}$ -EXCHANGE BETWEEN THIONYL CHLORIDE AND SULFUR DIOXIDE. David E. Burge and

T. H. Norris (Oregon State Coll., Corvallis). *J. Am. Chem. Soc.* **81**, 2329-32(1959) May 20.

Antimony pentachloride has been shown to have a pronounced inhibiting effect on the catalysis by tetramethylammonium chloride of the radiosulfur exchange reaction between thionyl chloride and liquid sulfur dioxide, the catalysis reaching a minimum at an antimony pentachloride concentration corresponding to hexachloroantimonate, thus confirming the formation of this complex. Aluminum chloride similarly gives inhibition, suggesting the formation of tetrachloroaluminate complex. Hydrogen chloride gives no inhibition either of catalysis by tetramethylammonium chloride or of that by antimony pentachloride, signifying the absence of any important complex-forming interaction in either of these cases. The results support the previously offered acid-base interpretation of catalysis in this system. (auth)

#### 14318

DISSOCIATION OF HYDROGEN IN A MICROWAVE DISCHARGE. T. M. Shaw (General Electric Co., Palo Alto, Calif.). *J. Chem. Phys.* **30**, 1366-7(1959) May.

Experimental study of the dissociation of  $\text{H}_2$  in a microwave discharge is reported. Maximum H atom yield was obtained at 0.5 mm Hg and was 25% less at 0.25 and 1.0 mm. For 100 watts of 3000 Mc power and a flow rate of  $10^{-5}$  moles/sec at 0.5 mm 90% dissociation was obtained, increasing with increased flow rate and reduced to 25% at  $1.5 \times 10^{-4}$  moles/sec. An energy efficiency value of  $6.5 \times 10^{-2}$  dissociations/ev was calculated. The results are in good agreement with those of others and indicate a collision cross section 2 to 3 times the theoretical value. (T.R.H.)

#### 14319

ION-EXCHANGE STUDIES OF PHOSPHATES. PART III. COMPLEX FORMATION BETWEEN TERVALENT METALS AND ORTHOPHOSPHORIC ACID. J. A. R. Genge and J. E. Salmon (Battersea Coll. of Tech., London). *J. Chem. Soc.*, 1459-63(1959) Apr.

Equilibrium batch experiments with various trivalent-metal (Al, Fe, Ti, In, Sc, Yb, Er, Nd, and La) forms of a strong cation-exchange resin and orthophosphoric and perchloric acid solutions are used to assess the degree of complex formation. Where possible, comparison is made with conclusions based on the results of pH titrations of the metal chloride solutions with phosphoric acid. With perchloric acid there is little sign of complex formation, but with phosphoric acid there is found a regular variation in the degree of complex formation with the ionic radius (non-hydrated) of the metal. There is an optimum ionic radius for complex formation of approximately 0.7 Å, corresponding closely to that of titanium(III) and a gradual decrease at higher or lower radii. An explanation of this is offered in terms of the ease of formation of a four-membered chelate ring, and it is shown that the optimum radius of 0.7 Å is that required to give the least strain and the minimum distortion of bond angles. (auth)

#### 14320

SPECTRA OF PROTACTINIUM (IV) AND (V) IN HYDROCHLORIC ACID. D. Brown, A. J. Smith, and R. G. Wilkins (Sheffield Univ., Eng.). *J. Chem. Soc.*, 1463-6(1959) Apr.

Spectral changes occurring when  $\text{Pa}^{5+}$  is reduced by zinc amalgam are noted. (auth)



**14321**

COMPOSITION AND APPARENT INSTABILITY CONSTANT OF URANYL 1-HYDROXY-2-NAPHTHOATE CHELATE. S. C. Tripathi and Satya Prakash (Allahabad Univ., India). *J. Indian Chem. Soc.* **36**, 19-22(1959) Jan.

The complex formation of uranyl with monosodium 1-hydroxy-2-naphthoate as a chelating agent was studied and its composition determined by Job's method of continuous variation. The complex is formed at pH 4.8 and contains uranyl and 1-hydroxy-2-naphthoate in 1:1 ratio, the color of the complex being deep red. It was suggested that in the complex formation the hydroxyl hydrogen of the naphthoate is displaced and oxygen atoms of carboxyl and hydroxyl groups share to form the complex. (auth)

**14322**

RADIATION-INDUCED EXCHANGE OF HYDROGEN CHLORIDE- $\text{Cl}^{36}$  AND PROPYL CHLORIDES.

Rowland E. Johnson and Charles E. Miller, Jr. (Florida State Univ., Tallahassee). *J. Phys. Chem.* **63**, 641-3(1959) May.

The  $\gamma$  irradiation of the two propyl chlorides has been studied, both alone and admixed with hydrogen chloride- $\text{Cl}^{36}$ . The principal radiolysis product is hydrogen chloride;  $G_{\text{HCl}}$  values are 3.38 for *n*-PrCl and 3.82 for *i*-PrCl. The isotopic exchange reaction is zero order in hydrogen chloride;  $G_{\text{exch}}$  values are 3.32 for *n*-PrCl and 1.27 for *i*-PrCl. A mechanism is suggested for the exchange. (auth)

**14323**

SALTING EFFECTS IN THE SOLVENT EXTRACTION BEHAVIOR OF INORGANIC COMPOUNDS. R. M. Diamond (Cornell Univ., Ithaca, N. Y.). *J. Phys. Chem.* **63**, 659-67(1959) May.

The variation in the distribution ratio for tracer indium(III) distributing between an oxygenated organic solvent and aqueous solutions of hydrochloric acid in which the concentration of HCl was varied while keeping the initial ionic strength constant with various chloride salts was studied as a model system for the extraction behavior of ionic species under these conditions. It is seen that the extraction of acid species plays a somewhat unique role due to the special ability of the hydronium ion to hydrogen-bond water molecules in first shell solvation and to enhance further coordination with the solvent molecules. In such acid extractions, the coordinating ability of the organic solvent, determined by its basicity and the steric availability of the donor atom, and not the solvent's dielectric constant, is of paramount importance. In contrast, the extraction of large, relatively unhydrated salt species, such as  $\text{N}(\text{C}_2\text{H}_5)_4^+\text{InCl}_4^-$ , depends primarily on the dielectric constant of the organic solvent and not on its coordinating ability. With solvents of high dielectric constant, i.e., nitrobenzene, the extraction of ionic species increases with increasing size of the ions. With solvents of low dielectric constant but good coordinating ability, such as diethyl ether, the extraction of hydrated cations decreases with increasing crystallographic size, exactly the reverse order. The variations in the extraction of the indium tracer with replacement of the aqueous HCl by the different salt chlorides are explained on the basis of (1) the creation of new extracting species involving an added ion and the ion of interest; (2) the creation of new extracting species not involving the ion of interest, but repressing the latter's extraction; (3) a change in the relative proportion of the extractable species in the aqueous phase; (4) a change in

the nature of the aqueous phase with changing water activity and dielectric constant. (auth)

**14324**

KINETICS OF THE REACTION BETWEEN URANIUM HEXAFLUORIDE AND SODIUM FLUORIDE.

II. SODIUM FLUORIDE PELLETS AND CRUSHED PELLETS. F. E. Massoth and W. E. Hensel, Jr. (Goodyear Atomic Corp., Portsmouth, Ohio). *J. Phys. Chem.* **63**, 697-702(1959) May.

A study of the kinetics of the reaction between uranium hexafluoride and sodium fluoride pellets and crushed pellets has been made over the temperature range 25 to 68°. Derivation of the logarithmic and parabolic laws for gas-solid reaction, involving a cubic particle, is presented. The reaction appears to proceed initially by a logarithmic mechanism and then by a parabolic mechanism. A blocking effect is advanced to explain the incomplete reaction with sodium fluoride pellets. A physical picture of the various steps of the reaction mechanism for the sodium fluoride-uranium hexafluoride reaction is presented. (auth)

**12325**

DEUTERIUM EXCHANGE BETWEEN WATER AND BOEHMITE ( $\alpha$ -ALUMINA MONOHYDRATE). ACTIVATION ENERGY FOR PROTON DIFFUSION IN BOEHMITE.

Yung-Kang Wei and Richard B. Bernstein (Univ. of Michigan, Ann Arbor). *J. Phys. Chem.* **63**, 738-41(1959) May.

The kinetics of the exchange of  $\text{D}_2\text{O}$  vapor with crystalline boehmite (particle size ca.  $1\ \mu$ ) were studied from 85-151°. The Berthier exchange ratio *C* (number of exchangeable atoms in the solid relative to vapor phase) ranged from 0.7 to 2.3. The  $\text{D}_2\text{O}$  pressure was varied from 0.41 to 0.95 atm. A rapid initial surface exchange preceded the slower diffusion-controlled exchange with the bulk crystal. After correction for this surface exchange the data followed the appropriate diffusion equation (spherical particle case). Due to the uncertainty in crystallite size absolute values of the diffusion coefficient *D* are in doubt by a large (but constant) factor. However, the temperature dependence of *D* furnishes a reliable value for the activation energy:  $E_D = 12.9 \pm 0.8$  kcal./mole. Auxiliary exchange experiments carried out with  $\text{D}_2\text{O}^{18}$  showed very slow exchange of  $\text{O}^{18}$  compared to that of deuterium. This suggests independent migration of protons (deuterons) and oxygen carrier ions through the boehmite lattice. (auth)

**14326**

$\gamma$ -RADIOLYSIS OF ETHYLENE. Kang Yang and Peter J. Manno (Continental Oil Co., Ponca City, Okla.). *J. Phys. Chem.* **63**, 752-3(1959) May.

Purified  $\text{C}_2\text{H}_4$  was irradiated in a facility using 4 MTR fuel elements. The products determined by gas-liquid partition chromatography were  $\text{H}_2$ ,  $\text{CH}_4$ ,  $\text{C}_2\text{H}_2$ ,  $\text{C}_2\text{H}_6$ , and *n*- $\text{C}_4\text{H}_{10}$ . The *G* values were independent of initial energy input rate, initial ethylene pressure, and surface-to-volume ratio of glass reactors. Formation of  $\text{C}_2\text{H}_6$  was completely inhibited by 5% NO indicating a free-radical mechanism. The NO did not affect *G*-values for  $\text{H}_2$ ,  $\text{C}_2\text{H}_2$ , and *n*- $\text{C}_4\text{H}_{10}$ . (T.R.H.)

**14327**

RADIATION INDUCED RACEMIZATION OF 1-MANDELIC ACID IN AQUEOUS SOLUTION. Paul Y. Feng and Stephen W. Tobey (Armour Research Foundation, Chicago). *J. Phys. Chem.* **63**, 759-60(1959) May.

Gamma radiolysis of aqueous mandelic acid was

followed by optical activity. Both racemization and destruction occurred. Optical activity decreased in all samples. Conventional radical mechanisms are offered. (T.R.H.)

#### 14328

RADIATION-INDUCED CATIONIC POLYMERIZATION OF BUTADIENE. W. S. Anderson (Shell Development Co., Emeryville, Calif.). *J. Phys. Chem.* **63**, 765-6 (1959) May.

Radiation polymerization of butadiene proceeds by the ionic route. The polymerization rate increased with decreasing temperature, a characteristic of cationic polymerizations. (T.R.H.)

#### 14329

HEAT OF FORMATION OF BORON TRICHLORIDE. Walter H. Johnson, Richard G. Miller, and Edward J. Prosen. *J. Research Natl. Bur. Standards* **62**, 213-17 (1959) May.

The heat of formation of gaseous boron trichloride has been determined by the direct reaction of gaseous chlorine with amorphous boron in a calorimeter.  $B(\text{amorph}) + 3/2 Cl_2(\text{gas}) = BCl_3(\text{gas})$   $\Delta H^\circ(25^\circ C) = -407.98 \pm 1.34$  kJ/mole ( $-97.51 \pm 0.32$  kcal/mole). By utilizing the values previously reported for the heats of formation of boric acid, diborane, and pentaborane, the heat of hydrolysis of boron trichloride and the heats of reaction of diborane and pentaborane with chlorine have been obtained. By the use of an estimated value for the heat of sublimation of boron, the average bond energy of the B-Cl bond in boron trichloride is found to be 105.2 kcal at 0°K. The data on the heats of formation of diborane, boric oxide, boric acid, and boron trichloride now form a consistent set of values. (auth)

#### 14330

DEVELOPMENTS IN HORIZONTAL PULSED CONTACTORS FOR LIQUID-LIQUID EXTRACTION PROCESSES. D. H. Logsdail (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and J. D. Thornton (University of Durham, Eng.). *Reactor Technol.* **1**, 15-24(1959) Apr.

An air-pulsed horizontal mixer-settler is described along with a horizontal pulsed-plate column which uses a single air pulse line regardless of the number of stages. Experimental setups and methods of operation are described and mass transfer data are given and discussed. It is concluded that the air-pulsed mixer-settler and the horizontal pulse column perform comparably with conventional equipment. Air-pulsing gives an advantage in corrosive and radioactive processing. The horizontal pulse column offers advantages over other horizontal contactors in ease of construction, maintenance, and stability of operation, and cascades are more compact, saving on shielding costs. (T.R.H.)

#### 14331

NEW DESIGNS FOR JET EXTRACTION COLUMNS. S. M. Karpacheva, L. P. Khorkhokina, and S. F. Medvedev. *Reactor Technol.* **1**, 60-3(1959) Apr.

Jet and spray columns are discussed and compared with other extraction apparatus. A six-stage jet column is described, and data from experiments with the six-stage column in a solvent extraction set-up are given. Multijet columns with phase inversion are also treated. (T.R.H.)

#### 14332

DETERMINATION OF THE IONIZATION POTENTIAL OF URANIUM ATOMS BY THE SURFACE IONIZATION METHOD. I. N. Bakulina and N. I. Ionov (Leningrad

Inst. of Physics and Tech.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1001-5(1959) Apr. (In Russian)

A method is described for determining the ionization potentials of two types of atoms which are simultaneously ionized on a heated metallic surface. The method was checked by measuring the ionization potential differences of sodium and lithium. The difference of the ionization potential of uranium and lithium was measured. The ionization potential of uranium was found to equal  $6.08 \pm 0.08$  v. At high temperatures the current of positive ions of sodium, lithium, and uranium varies with the temperature in accord with the theoretical formula for surface ionization (auth)

#### 14333

KINETICS OF THE REDUCTION OF  $ZrI_4$  VAPORS BY METALLIC ZIRCONIUM. F. I. Busol (Khar'kov Inst. of Physics and Tech.). *Zhur. Fiz. Khim.* **33**, 799-807 (1959) Apr. (In Russian)

A method is described for determining the kinetics of formation of the lower zirconium iodides on interaction of the tetraiodide with metallic zirconium. The method is based on continuously following the changes (decreases) in vapor pressure of the  $ZrI_4$  vapors as they are being reduced to the little volatile lower iodides. It was found that at zirconium temperatures of 300 to 530°C and tetraiodide pressures 10 to 250 mm Hg the  $ZrI_4$  molecules are reduced mainly to  $ZrI_3$ . The reaction takes place on the metal surface with the formation of a strong  $ZrI_3$  film. Evidently under these conditions zirconium diiodide does not form. For a given temperature of the zirconium the rate of growth of the triiodide layer with time obeys a parabolic law, the constant of the parabolic law depending exponentially on the temperature. For the activation energy of the process which determines the rate of the reaction studied the value  $Q \approx 21$  kcal/mole. Such a process is evidently diffusion of the atoms or ions of zirconium through the  $ZrI_3$  layer. (auth)

#### 14334

THE BOND ENERGY OF THE SURFACE OF THE METALLIC CATALYSTS WITH HYDROGEN AND DEUTERIUM. S. L. Kiperman and A. A. Balandin (Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). *Zhur. Fiz. Khim.* **33**, 828-34(1959) Apr. (In Russian)

The bond energies of nickel, iron, platinum, and palladium surfaces with hydrogen and deuterium were calculated by a kinetic method. The calculations were based on the reactions of the para-ortho conversion of hydrogen, the ortho-para conversion of deuterium and the isotopic exchange between hydrogen and deuterium. Differences in catalytic activity have little effect on the bond energy values. The values obtained for the different catalysts are close to each other, which led to the conclusion that the reaction on the different surfaces occurs predominantly on the active sites, characterized by optimal bond energies. A discussion is presented of the causes for the possible difference in bond energy values obtained by the kinetic method and from the heats of adsorption. (auth)

## Radiation and Radiochemistry

#### 14335 AD-210342

General Mills, Inc., Minneapolis.

A STUDY OF THE EFFECTS OF IONIZING RADIATION ON SUGARS. Report No. 3 (Annual) [for] April 1,



1957—March 31, 1958. J. S. Andrews. 15p. Project No. 7-84-01-002. Contract QMR&E (Natick) No. 78.

Experiments describing certain effects of gamma radiation on simple sugars are reported. Glucose has received the most attention, and the following effects are noted: decrease in pH; formation of an ultra-violet absorption peak in the 265 to 275 millimicron region when glucose is irradiated in solution; positive ene-diol reaction; formation of  $H_2$ ,  $CO_2$ , and CO during irradiation of crystalline glucose; reaction with dinitrophenylhydrazine and formation of a lead salt which is insoluble in acetone; indication of several as yet unidentified radiation products by means of paper chromatography; occurrence of a post-irradiation effect. The influence of various conditions, such as pH and concentration, has also been studied. A search for an adequate technique for separation of the radiation products from unchanged glucose is in progress. Certain effects similar to those reported in the case of glucose have also been observed when sucrose, fructose, galactose, or lactose are irradiated. A small, thimble-type ionization chamber is described. To measure the ion-currents from this chamber an accurate current integrator has been constructed. The chamber saturation properties are such that an operating potential of 450 volts is sufficient to collect all of the ions. The energy response can be altered by modification of the design, but this property has not, as yet, been thoroughly investigated. Calibration has been obtained by comparison with the ceric sulfate dosimeter and an adiabatic calorimeter. These calibration methods agree within the estimated errors. The Henley cellophane-dye dosimeter has been used, under conditions of controlled humidity, to measure depth-dose properties of accelerated electrons. A source comparison study with an 8 Mev linear accelerator shows close agreement with the cobalt-60 calibration of these films. Further work with this dosimeter is in progress. (auth)

**14336** AERE-C/R-2377(1)

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

GAMMA RAY SPECTROSCOPY APPLIED TO RADIO-ACTIVATION ANALYSIS. PART I. INTRODUCTION AND NUCLEAR DATA. L. Salmon. Feb. 1959. 98p. \$1.82(BIS).

A tabular summary of nuclear data relevant to neutron activation analysis is given together with experimentally determined gamma-ray spectra of nuclides produced by neutron absorption, whose half lives are greater than 4.5 minutes. Consideration is given to the application of this data to gamma-ray spectroscopy in neutron activation analysis. (auth)

**14337** HW-47867 (Rev.) (Del.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A GAMMA-COUNTING METHOD FOR THE DETERMINATION OF U-235 IN ENRICHED URANIUM. U. L. Upson and D. G. Miller. Feb. 1, 1959. Decl. with deletions May 7, 1959. 24p. Contract [W-31-109-Eng-52]. \$4.80 (ph), \$2.70 (mf) OTS.

A method of precision gamma counting has been developed and applied to the determination of the  $U^{235}$  isotopic content, at about 93 percent enrichment, in uranium-aluminum alloys. The counting is performed on liquid samples obtained from dissolution of the alloy without chemical separation, and is precise to within 0.2 percent standard deviation in replicate samples.

The accuracy of an isotopic analysis by this method is dependent upon the use of accurate standards and upon the accuracy of the separate analysis for total uranium. For samples in which the total uranium content is accurately known, as in the case of solutions of pure uranium, weighed as  $U_3O_8$ , a precision of  $\pm 0.3$  percent at 95 percent confidence can be attained. For samples in which the total uranium content is determined by chemical analysis, the over-all precision ranges from  $\pm 0.4$  percent to  $\pm 0.8$  percent of the total uranium content. While gamma counting is not competitive with the mass spectrometer in precision, its virtue lies in the relative speed and economy with which samples can be evaluated, and in the fact that a mass spectrometer is not always readily available. (auth)

**14338** NP-7515

RADIOLITICHESKOE VOSSTANOVLENIE

AMERITSIYA (VI) I AMERITSIYA (V). (Radiolytic Reduction of Americium(VI) and Americium(V).) A. A. Zaitsev, V. N. Kosyakov, A. G. Rykov, Yu. P. Sobolev, and G. N. Yakovlev. [nd]. 28p.

The rate constants for radiolytic reduction of  $AmO_2^{2+}$  in hydrochloric, sulfuric, and nitric acids were determined by the yield of radiolytic products. The obtained magnitudes combined with the given hydrogen peroxide yield are used for evaluating the  $H^+$  contributions to the general reduction reaction. A method is suggested for the radiolytic reduction of  $AmO_2^{2+}$  and  $AmO_2^+$ . The expression of the  $AmO_2^+$  reduction rate is used for determining the yield of  $H_2O_2$  and  $H^+$  in the investigated solutions. (R.V.J.)

**14339** NP-7546

Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw.

THE EFFECTS OF NUCLEAR TRANSFORMATIONS IN THE BROMATES. PART I. THE DISINTEGRATION OF BROMATE ION BY ISOMERIC TRANSITION. Report No. 61/V. I. G. Campbell. Jan. 1959. 18p.

The chemical effects of isomeric transition in bromate in solution were studied. Evidence has been found for the existence of an unstable bromite fragment, the  $Br^{80}$  of which comes to be present as bromate in aqueous solutions but which can be reduced to lower valency forms in solution by methanol, and possibly oxidized to bromate by oxidizing agents. Charge neutralization of 18 min  $Br^{80}$  present in lower valency forms does not lead to formation of bromate, and stable  $Br-O$  bond formation during discharge of bromite fragments appears theoretically improbable. Bromite fragments do not undergo hydration at high pH values. The effects of isomeric transition in bromate are compared with effects of (n, $\gamma$ ) reactions in oxy-anions. (auth)

**14340** NS-3

New Zealand. Dept. of Scientific and Industrial Research. Div. of Nuclear Sciences, Lower Hutt.

ISOTOPIC ENRICHMENT BY GASEOUS THERMAL DIFFUSION METHODS AND ITS APPLICATION TO  $^{14}C$  ENRICHMENT. J. Denman. May 9, 1958. 25p.

The theory of thermal diffusion is treated in some detail, and a column design which will enrich  $C^{14}$  in 20 l of  $CO_2$  by a factor of eight in a reasonable time and at a reasonable cost is investigated. (T.R.H.)

**14341** TID-7556

Oak Ridge National Lab., Tenn.

SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. Frank Ring, Jr., comp. Apr. 1959. 171p. \$1.75(OTS).

Papers contained in this report supplement a book of papers published in 1958, American Institute of Chemical Engineers, New York.

Eighteen papers are presented on design, equipment, and operation of hot laboratories. Minutes of a round table panel discussion presented at the conference are included. (W.D.M.)

**14342** TID-7556(p.23-6)

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.

A CORROSION TEST FACILITY FOR IRRADIATED SAMPLES. A. L. Maharam. p.23-6 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.

An important characteristic of nuclear reactor element is their corrosion resistance at elevated temperatures. A test facility, located at the Bettis Plant Hot Laboratory, is described in which corrosion tests are performed on radioactive materials. The design of the equipment is such that a minimum use of hot cell time is required. It consists of individually shielded, portable autoclaves and associated apparatus. The facility has proved to be effective and requires little maintenance. (auth)

**14343** TID-7556(p.27-44)

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. THE DESIGN OF THE IDAHO EXPENDED CORE FACILITY. C. E. Langlois. p.27-44 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 18p.

It has been recognized for some time that there is much to be learned from a core after it has been taken out of operation. A plant is under construction at NRF, Idaho which will be equipped to cut up, and analyze cores as well as to prepare the fuel-bearing material for re-covering of fuel by a chemical processing plant. A brief description of the special design features of the facility and the reasons for them are given. (auth)

**14344** TID-7556(p.45-8)

Knolls Atomic Power Lab., Schenectady, N. Y. THE HOT LABORATORY FACILITY AT KNOLLS ATOMIC POWER LABORATORY. D. D. LaRocque. p.45-8 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.

The hot laboratory facilities at KAPL are illustrated, and the functions are summarized. Supporting facilities are listed. (W.D.M.)

**14345** TID-7556(p.49-61)

Argonne National Lab., Lemont, Ill. HOT LABORATORY PROBLEMS IN ISOLATING GRAM QUANTITIES OF TRANSPLUTONIUM ELEMENTS. C. H. Youngquist and P. R. Fields. p.49-61 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 13p.

It is shown how the experience gained in processing small research quantities of irradiated plutonium will be applied to the processing of irradiated plutonium fuel assemblies. The material being processed is about 300 times greater than the earlier research samples and will present problems in methods and equipment for processing. In addition, the proportionately higher neutron

emission from the transplutonium elements will require the use of neutron caves as a substitute for glove boxes. (auth)

**14346** TID-7556(p.62-4)

Argonne National Lab., Lemont, Ill.

HOT LABORATORY OPERATIONS AT ARGONNE NATIONAL LABORATORY. William B. Doe. p.62-4 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 3p.

The physical and metallurgical testing hot laboratory at Argonne is a general purpose facility available for use by all of the divisions of the laboratory. It is designed for non-chemical or "dry" examination and testing of highly radioactive materials. The general layout is illustrated and the equipment is discussed. (W.D.M.)

**14347** TID-7556(p.65-8)

Du Pont de Nemours (E.I.) & Co. Savannah River Lab., Augusta, Ga.

OPERATIONAL ASPECTS OF HOT LABORATORIES. G. J. Deily. p.65-8 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.

The kilocurie cave facility at the Savannah River Laboratory consists of three caves in a single cell block. The general layout is illustrated and equipment and services are discussed. (W.D.M.)

**14348** TID-7556(p.69-72)

Oak Ridge National Lab., Tenn.

HOT CELL OPERATIONS, SOLID STATE DIVISION, OAK RIDGE NATIONAL LABORATORY. E. S. Schwartz. p.69-72 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.

The physical layout of hot cell operations at ORNL is illustrated, and equipment and services are discussed. A brief description of the facility and organization is given as a background for further discussion. (W.D.M.)

**14349** TID-7556(p.73-80)

General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho.

NEW MULTI-CELL FACILITY IN IDAHO. D. C. Durrill and R. D. Dwigans. p.73-80 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 8p.

Construction of a new facility comprising four small hot cells is nearly complete at the Aircraft Nuclear Propulsion test station operated by the General Electric Company in Idaho. Special features include split-level operating areas, concrete-filled vault-type doors for personnel and equipment entry, a remotely-operated underfloor dolly system, and a remote vacuum cleaning and wash down system. (auth)

**14350** TID-7556(p.81-95)

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.

DENSITY MEASUREMENT PROBLEMS IN HOT CELLS. K. Stratton. p.81-95 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 15p. (WAPD-T-670).

Previously abstracted as WAPD-T-670, NSA 12-9690.



**14351** TID-7556(p.96-9)

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh.

BETTIS HOT LABORATORY OPERATIONS. R. R. Fouse. p.96-9 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.

The physical layout of the Bettis Hot Lab. is briefly reviewed and illustrated. Support facilities and services are listed. (W.D.M.)

**14352** TID-7556(p.100-12)

Brookhaven National Lab., Upton, N. Y. SOME SAFETY RECOMMENDATIONS PERTINENT TO HOT LABORATORIES. L. G. Stang, Jr. p.100-12 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 13p. (BNL-3641).

Previously abstracted as BNL-3641, NSA 12-7727.

**14353** TID-7556(p.113-16)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash. HOT LABORATORY PANEL DISCUSSION AT THE SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, 1958 NUCLEAR CONGRESS, MARCH 16-21, 1958. L. D. Turner. p.113-16 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 4p.

The layout of the Radiometallurgy Laboratory at Hanford is illustrated and equipment is discussed. Operation and services are briefly reviewed. (W.D.M.)

**14354** TID-7556(p.117-22)

General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho. A CONDUCTING PLASTIC FOR METALLOGRAPHIC SPECIMEN MOUNTS. D. C. Durrill. p.117-22 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 6p.

It is difficult to prepare good surfaces for metallographic studies on some alloys without electrolytic etching. Copper-filled mounting powders available for such use require excessively high mounting pressures. A method of loading Bakelite with graphite to obtain conducting mounts with electrical resistances of from one to several thousand ohms is described. Resistances may be closely controlled by proportioning the mix appropriately. (auth)

**14355** TID-7556(p.123-9)

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh. MODIFICATIONS TO MASTER SLAVES AT BETTIS HOT LABORATORY. E. H. Stearns. p.123-9 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 7p.

Several modifications were made to both Argonne Model 4 and Model 8 Master-Slave Manipulators to meet the operating conditions at Bettis. Most of these modifications were made to increase the capacity or prevent failures on the original units. (auth)

**14356** TID-7556(p.130-4)

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh. A CONTINUOUSLY RECORDING MICROMETER-

PROFILOMETER FOR HOT LABORATORY APPLICATIONS. K. Stratton. p.130-4 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 5p.

An instrument is described which provides a continuous record of thickness change or surface profile for irradiated plate and rod specimens. Two linear displacement transducers are oriented in an opposed position and the samples are moved between roller actuators at a preselected speed, providing suitable recorder magnification. Total dimension changes obtained in this manner are independent of sample warpage or bowing. Disconnecting one transducer provides a surface contour with high resolution of surface defects. Samples 6" high, 8" wide, and 16" long are accommodated. Routine accuracies of 0.5 to 0.1 mils can be obtained under normal hot cell operating conditions. (auth)

**14357** TID-7556(p.135-54)

Westinghouse Electric Corp. Bettis Atomic Power Div., Pittsburgh. REMOTE METALLOGRAPHIC EQUIPMENT AND PRACTICES. F. M. Cain and F. O. Bingman. p.135-54 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 20p.

A review of equipment and practices used in the remote metallographic facility at Bettis is presented. The modifications of various pieces of equipment are outlined in addition to their operation and advantages. Deviations from normal operations or special techniques are discussed for specific operations. There are sections on the construction of the basic cell, the supporting equipment such as the liquid waste disposal system, design and operation of a remote sectioning machine, mounting techniques, grinding and polishing procedures, etching equipment and techniques, transfer and storage facilities, photography, hardness testing, and operating techniques for specific materials as related to the problems encountered in processing radioactive materials. (auth)

**14358** TID-7556(p.155-9)

Argonne National Lab., Lemont, Ill. COLORATION OF SHIELDING WINDOW GLASSES. K. R. Ferguson and R. L. Reed. p.155-9 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 5p.

Gamma irradiation tests on commercially produced shielding glasses with sp. gr. of 2.7 and 3.3 were extended to  $10^{10}$ r. Data on the rate of fading after exposure and the rate of re-coloring with re-exposure are included. Data are presented on the effect of the intensity of irradiation and the temperature during irradiation on the total coloration produced by a given exposure. Results of tests on experimentally melted glasses with improved resistance to coloration are included. (auth)

**14359** TID-7556(p.160-7)

Argonne National Lab., Lemont, Ill. SHIELDING WINDOW DESIGN FOR THE EBR-II PROCESS BUILDING. K. R. Ferguson and L. M. Safranski. p.160-7 [of] SIXTH HOT LABORATORIES AND EQUIPMENT CONFERENCE, MARCH 19-21, 1958, INTERNATIONAL AMPHITHEATRE, CHICAGO, ILLINOIS. 8p.

The shielding window design for the facility for processing and refabrication of fuel elements for the Experi-

mental Breeder Reactor No. II is described. The window is designed for a gamma radiation intensity up to  $10^6$  r/hr for eight hours per day. Steel shutters will shield the window when it is not in use. The design reasons for the window configuration and the choice of materials are discussed. Operation of the plant in an inert atmosphere requires a gas tight seal at the window aperture. The design details of the seal and test data on its performance are included. Also, data are included on the computed light transmittance of the window before and after a  $10^{10}$  r exposure. (auth)

#### 14360 USNRDL-TR-317

Naval Radiological Defense Lab., San Francisco.  
YIELDS IN FERROUS SULPHATE SOLUTIONS IRRADIATED WITH LOW ENERGY X RAYS. J. F. Pestaner and L. H. Gevantman. Apr. 23, 1959. 11p.

The yields ( $G(\text{Fe}^{3+})$ ) for  $\text{FeSO}_4$  solutions in 0.1 N  $\text{H}_2\text{SO}_4$  irradiated with 14- and 35-kev x rays were measured. They are  $14.4 \pm 0.7$  and  $14.8 \pm 0.7$ , respectively. These values are shown to be in agreement with those of other investigators when plotted as  $G(\text{Fe}^{3+})$  vs.  $\log 1/\text{LET}$ . (auth)

#### 14361 AEC-tr-3692

THE SEPARATION TUBE. V. PREPARATION OF  $\text{O}^{18}$ . K. Clusius and G. Dickel. Translated for Oak Ridge National Lab. from *Z. physik Chem. (Leipzig)* 193, 274-86(1944). 20p. \$3.30(ph), \$2.40(mf) JCL. (Figures Omitted).

The construction and operation of a separating tube installation of 82 m length, designed on the cascade tube principle, are described. The separating tubes are freely suspended in six units of 13.7 m length, are equipped with heat resistant platinum wires as heating elements, and are cooled by an external water spray. The installation attains a total separating factor of  $10^5$  with the use of oxygen. (auth)

#### 14362 CEA-tr-R-641

PRÉPARATION ET ÉTUDES DE PROPRIÉTÉS DE QUELQUES COMPLEXES OXALIQUES DU PuVI (Preparation and Study of the Properties of Some Pu(VI) Oxalic Complexes.) A. D. Gelman (Guelman) and L. E. Drabkina. Translated into French by B. de Trezvinsky from *Zhur. Neorg. Khim.* 3, 1105-8(1958). 10p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 3633.

#### 14363 CEA-tr-R-642

PRÉPARATION ET ÉTUDE DES PROPRIÉTÉS DE CERTAINS CARBONATES DE PuVI (Preparation and Study of the Properties of Some Pu(VI) Carbonates.) L. E. Drabkina. Translated into French by B. de Trezvinsky from *Zhur. Neorg. Khim.* 3, 1109-10(1958). 6p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 13, as abstract No. 3634.

#### 14364

USES AND LIMITATIONS OF MEASUREMENTS OF RATES OF ISOTOPIC EXCHANGE AND INCORPORATION IN CATALYZED REACTIONS. P. D. Boyer (Univ. of Minnesota, Minneapolis). *Arch. Biochem. Biophys.* 82, 387-410(1959) June.

Equations are given for the rate of enzymic reactions at equilibrium in terms of velocity constants and concentrations of enzyme and reactants. Relationships are developed for reactions of the type  $A \rightleftharpoons B$  and  $A + B \rightleftharpoons C + D$ . The general equation for the latter type may be

used to derive relationships for simpler systems and for reactions involving compulsory order of combination of enzyme and substrates. The relationships show, among other things, that measurements of isotopic exchange rates at equilibrium can lead to determinations of dissociation constants for enzyme-substrate intermediates in some simple systems. The relationships may also be useful in detection of compulsory orders of combination of reactants with an enzyme. Equations for the relative rates of exchange of two reactants in an enzymic reaction define clearly conditions where these rates may be unequal and independent of steps in which covalent bonds are formed or broken. Limitations of exchange data to predict occurrence of reaction steps involving covalent bond formation are pointed out. In addition, the considerations impose severe and insufficiently recognized limitations on the measurements of the relative rates or amounts of isotope incorporation for prediction of the occurrence or importance of metabolic pathways. (auth)

#### 14365

THE COMPOUND  $\text{URh}_3$ . Riccardo Ferro (Università, Genoa). *Atti accad. nazl. Lincei Rend. classe sci. fis. mat. e nat.* 25, 189-91(1958) Sept.-Oct. (In Italian)

The preparation and properties of  $\text{URh}_3$  are described. Powders of the two metals, compressed together into a block, are heated slowly in a vacuum to  $1200^\circ\text{C}$  and then cooled slowly to room temperature. The compound obtained was compact, brittle, and hard, and it did not react with the atmospheric constituents. X-ray-diffraction studies showed that the lattice structure is of the  $\text{AuCu}_3$  type and that the lattice constant is  $a_0 = 3.992 \text{ \AA}$ . The intensities of the Debye reflections are tabulated. (J.S.R.)

#### 14366

THE DETERMINATION OF BORON IN GLASS USING RADIUM-BERYLLIUM NEUTRON SOURCE (NEUTRON ABSORPTION TECHNIQUE). Yuzuru Kusaka (Kōnan Univ., Kōbe, Japan). *Bull. Chem. Soc. Japan* 31, 917-20(1958) Nov.

The neutron absorption technique using radium-beryllium neutron source was shown to be useful for rapid assay of boron in the samples containing other low cross section elements. This method may also be useful for the analyses of other high cross section elements. (auth)

#### 14367

THE DECOMPOSITION OF SOLID POTASSIUM CHLORATE BY X RAYS. H. G. Heal (Univ. of British Columbia, Vancouver, Can.). *Can. J. Chem.* 37, 979-87 (1959) May.

Potassium chlorate irradiated with x rays was found to contain chloride, chlorite, hypochlorite, occluded oxygen, dichlorine hexoxide, and a trace of chlorine dioxide. The chlorite and hypochlorite appear to decompose during irradiation to chloride. G values are given for  $25^\circ$  and  $-196^\circ$ . They vary little with temperature or dose rate. (auth)

#### 14368

LOW TEMPERATURE IRRADIATION OF MIXTURES OF  $\text{HBr}$  and  $\text{C}_2\text{H}_4$ . D. A. Armstrong and J. W. T. Spinks (Univ. of Saskatchewan, Saskatoon, Can.). *Can. J. Chem.* 37, 1002-3(1959) May.

A 90-c cobalt-60 source was used to irradiate solid equimolar mixtures of  $\text{HBr}$  and  $\text{C}_2\text{H}_4$  at  $-218$  and  $-209^\circ\text{C}$  and liquid mixtures at  $-165^\circ\text{C}$ . An addition reaction was observed at all three temperatures, the product of which was identified as ethyl bromide. (J.R.D.)



## 14369

IRRADIATION OF AQUEOUS CHLORAL HYDRATE WITH  $\text{Sr}^{90}$ — $\gamma^{90}$  BETA RAYS. R. F. Platford and J. W. T. Spinks (Univ. of Saskatchewan, Saskatoon, Can.). Can. J. Chem. **37**, 1022-8(1959) June.

Air-saturated aqueous chloral hydrate has been irradiated with beta rays and the acid yield as determined by titration has been studied as a function of dose rate, temperature, and initial concentration of the chloral hydrate. The average lifetime of the intermediates has been found, by means of the rotating sector technique, to be about 0.5 second. Propagation and termination rate constants for the reaction have been calculated and an effort has been made to explain the results observed in terms of a free radical chain reaction. (auth)

## 14370

ISOTOPIC AND HOT RADICAL EFFECTS IN THE REACTION OF HYDROGEN ATOMS WITH ETHYLENE. A. H. Turner and R. J. Cvetanović (National Research Council, Ottawa). Can. J. Chem. **37**, 1075-81(1959) June.

Reactions of D atoms with  $\text{C}_2\text{H}_4$ , H atoms with  $\text{C}_2\text{D}_4$ , and H atoms with  $\text{C}_2\text{H}_4$  at room temperature are compared. Pronounced differences in the extent of isotopic exchange have been found. The observed isotopic and pressure effects provide evidence for the importance of "hot" ethyl radicals in these reactions and their responsibility for isotopic exchange. The atoms are generated by the mercury-photosensitized decomposition of hydrogen and deuterium and their concentration is sufficiently small so that "atomic cracking" does not occur. (auth)

## 14371

THE PURIFICATION, DETERMINATION, AND NEUTRON CAPTURE CROSS SECTION OF ACTINIUM-227. M. J. Cabell (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Can. J. Chem. **37**, 1094-1103(1959) June.

Procedures are described for the separation by ion exchange chromatography of submicrogram quantities of  $\text{Ac}^{227}$  from its daughters and the absolute determination of  $\text{Ac}^{227}$  by measurement of the rate of growth of  $\alpha$ -particle emission from an initially pure source. These procedures are utilized in the determination of the reactor and thermal neutron capture cross sections and the resonance capture integral of  $\text{Ac}^{227}$  by an activation method. Assuming 36.5 barns for the thermal neutron capture cross section of  $\text{Co}^{59}$ , a value of  $\sigma_{2200} = 814 \pm 13$  barns has been obtained for  $\text{Ac}^{227}$ . The resonance capture integral (from 0.5 ev to  $\infty$ ) was found to be  $1177 \pm 19$  barns relative to 48.6 barns for the resonance capture integral of  $\text{Co}^{59}$ . (auth)

## 14372

OXIDIZING PROPERTIES OF ATOMIC HYDROGEN IN THE RADIATION OXIDATION OF FERROUS IONS. V. N. Shubin and P. I. Dolin. Doklady Akad. Nauk S.S.S.R. **125**, 1298-1300(1959) Apr. 21. (In Russian)

Measurements were taken of the oxidation of divalent iron, irradiated by  $\text{Co}^{60}$   $\gamma$  rays, in molecular hydrogen concentrations corresponding to  $\text{H}_2$  pressure over the solution at 1 to 180 atm. (R.V.J.)

## 14373

FUNDAMENTAL PROBLEMS OF THE RADIOLYSIS OF AQUEOUS SOLUTIONS. M. Haissinsky (Université, Paris). Inds. atomiques **3**, No. 3/4, 37-46(1959). (In French)

A résumé of experimental data is presented on the radiolysis of dilute aqueous solutions by ionizing radiations. The practical and efficient transformation of radiation energy to useful chemical energy is briefly considered. (J.S.R.)

## 14374

FURTHER OBSERVATIONS ON THE RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS OF THIOUREA. W. M. Dale and J. V. Davies (Christie Hospital, Manchester, Eng.). Intern. J. Radiation Biol. **1**, 189-95 (1959) Apr.

Aqueous solutions of thiourea labelled with either  $\text{C}^{14}$  or  $\text{S}^{35}$  have been irradiated with  $\gamma$  rays and high energy electrons. Chromatographic analysis of the irradiated solutions identified cyanamide, dicyandiamide and guanylthiourea; guanidine sulfate is probably another degradation product. These radiation products have been confirmed by the use of different solvents and sprays as well as by radioactive counting. Quantitative estimates of the yield of cyanamide have been made and differences between decomposition caused by light quanta and high energy radiation are discussed. (auth)

## 14375

THE QUESTION OF RADIATION-INDUCED PHASE CHANGES. Ulrich Gonser and Boudewyn Okkerse (Univ. of Illinois, Urbana). Phys. and Chem. Solids **7**, 55-7 (1958) Oct.

Radiation-induced phase changes can give valuable information about the nature of thermal-spike regions. Recent experiments suggest the following classification: (1) If  $dV/dT$  is always positive, even at the transformation point, the thermal spike is a region containing Frenkel pairs or many displaced atoms, as in the "displacement spike" of Brinkman. (2) If  $dV/dT$  has an anomaly, corresponding to an increase of density due to the formation of a more closely packed phase, one may expect the more dense phase to be produced in a "structure spike." In the latter case the high pressure which a thermal spike exerts on the surrounding matrix is an important factor in creating the high-temperature phase. (auth)

## 14376

CHEMICAL ANALYSIS USING 1.5-Mev PROTONS. M. Mazari, L. Velázquez, and F. Alba (Universidad Nacional Autónoma, Mexico). Rev. mex. fis. **8**, 1-16 (1959). (In Spanish)

Improvements made on the equipment, necessary to undertake precise studies of nuclear reactions, are briefly described. Among the principal changes that must be mentioned are the substitution of the arc for a radiofrequency ion source, including an accelerator tube with only one electrostatic lens; the changes in the deflector magnet to reduce background of scattered particles; the installment of a strong focusing electrostatic lens; and a mechanism for rotating thin targets which prolong their useful life noticeably. A chemical analysis of compounds is possible with purely physical methods, for instance, the magnetic analysis of elastic protons scattered from the target with different energies, by means of a broad range magnetic spectrograph. Copper and clay targets were used, and examples of the spectra produced by the scattering of monoenergetic 1.54 Mev protons are included. Experiments with protons or deuterons on thick targets proved to be negative. The presence of a high percentage of Fe in the clay of the Valley of México and information obtained from other sources suggest that they may be classified

in the Ilite group rather in the Montmorillonites as they have generally been reported. (auth)

**14377**

METHODS FOR THE DETERMINATION OF STRONTIUM-90. Adelaida Palacios, T. A. Brody, and Ana Marfa Martínez (Universidad Nacional Autónoma, Mexico). *Rev. mex. fis.* 8, 27-41(1959). (In Spanish)

Two methods of radiochemical separation of strontium 90 in picocurie concentrations are described. One is based on classical analytical methods and requires a considerable number of different steps. The other gives a much simpler procedure by use of a chromatographic column. In the latter, Dowex 50 type cation exchange resin is employed, and the eluting agent is 1.2M ammonium lactate at pH 5.5. This separates both the alkaline earths and yttrium, avoiding the need for two successive yttrium milkings. Methods of sample preparation are discussed, and a brief note on counting arrangements is given. (auth)

**14378**

CONTRIBUTION OF NUCLEAR EMULSIONS TO THE STUDY OF SOME CASES OF MICRORADIOCHEMICAL ANALYSIS. Giovanna Mayr (Università, Milan). *Ricerca sci.* 29, 804-9(1959) Apr. (In Italian)

A method is described, based on the count of the terminal parts of the beta ray tracks in nuclear emulsions, for the estimation of small amounts of a beta emitter, even when its beta rays are highly energetic. At the same time another method is demonstrated, based on the same principle, for the determination of small amounts of a beta-emitting isotope mixed with another isotope emitting betas of higher energy. (auth)

**14379**

SEPARATION OF HYDROGEN ISOTOPES BY GAS-SOLID CHROMATOGRAPHY. Preston L. Gant and Kang Yang (Continental Oil Co., Ponca City, Okla.). *Science* 129, 1548-9(1959) June 5.

Conditions are described for the chromatographic analysis of mixtures of  $H_2$ , HT, and  $T_2$  on a molecular sieve column. This technique may find valuable applications in various kinetic investigations. (auth)

**14380**

ELECTROPHORETIC METHOD FOR DESALTING AMINO ACIDS. James C. Nichol (Oak Ridge National Lab., Tenn.). *Science* 129, 1549-50(1959) June 5.

A solution to be desalted is placed on a paper strip along which an ammonium formate buffer gradient has been established. Application of a potential brings about migration of amino acids to their isoelectric pH's and removal of salt ions. The strip is eluted with water, and the eluate is freed of ammonium formate by vacuum sublimation at 40°C. (auth)

**14381**

ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF FROZEN OH RADICALS. S. D. Kaitmazov and A. M. Prokhorov (Lebedev Inst. of Physics, Academy of Sciences, USSR). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 1331-2(1959) Apr. (In Russian)

The spectra of radicals obtained in frozen  $H_2O_2$  irradiated with ultraviolet were studied. The electron paramagnetic resonance spectra were observed at frequencies of 12,000, 9,400, 2,600, 1,300, and 850 MHz. The OH $\cdot$  spectra coincided with the spectrum obtained from discharge radicals. A doublet with a distance between the components ( $12 \pm 1$  G), produced by the proton nuclear moment, was clearly observed at the 850 MHz frequency. The shape of the derived absorption line at

12,000 MHz can be explained by the anisotropic widening and superfine spallation. (R.V.J.)

**14382**

REACTIONS INVOLVING IRRADIATION. Esso Research and Engineering Co. (U.S.A.). British Patent 802,552. *Nuclear Eng.* 4, 238(1959) May.

A method is described whereby organic materials are irradiated in the presence of a solute which, on neutron capture, emits an appreciable amount of alpha particles of high kinetic energy. The presence of such an accelerating solute was found to promote effectively the radiochemical conversion of the reactant. The results of the method are particularly beneficial in hydrocarbon conversion processes as carried out in a nuclear reactor. Among suitable accelerating materials, boron-10 and lithium-6 are of primary interest.

**14383**

ELECTROLYTIC SEPARATION OF ISOTOPES. Soc. d'Electro-Chemie, d'Electro-Metallurgie et des Aciéries Electriques d'Ugine (France). British Patent 802,555. *Nuclear Eng.* 4, 238(1959) May.

Various electrolytic methods are in use for the separation of isotopes. All use uniform direct current and in the case of amalgamable metals such as lithium, a continuously renewed mercury cathode is provided to remove the metal from the electrolyte. This arrangement can be employed for the separation of lighter and heavier isotopes from a liquid electrolyte, derived from an isotope element such as lithium, by applying a square pulsed voltage at intervals across the electrodes of the electrolytic cell. Under the action of the pulse, the various isotopic ions reach different velocities and, as a result, the ions of the lighter isotope concentrate in the region of the cathode. By arranging for the rapid removal of the ions at each pulse the proportion of the lighter isotope in the mixture withdrawn from the electrolyte is increased. At the same time the proportion of the heavier isotopes in the remaining electrolyte rises accordingly. If the operation is continued for a sufficiently long period, progressive enrichment will result in complete separation. Details of the method and results obtainable are given for the separation of Li-6 and Li-7 using a saturated aqueous solution of lithia as the electrolyte.

## Separation Processes for Pu and U

**14384** BNL-381

Brookhaven National Lab., Upton, N. Y. CALCINING OF WASTES; PROGRESS REPORT ON WASTE PROCESSING DEVELOPMENT PROJECT.

S. Zwickler and B. Manowitz. Jan. 1956. Dec. June 8, 1959. 15p. \$3.30(ph), \$2.40(mf) OTS.

The calciner concept of waste processing is based on the idea of incorporating into radiochemical waste solutions a salt that melts at a reasonable temperature, has an appreciable fluid range, and is not too viscous. This salt serves as a transport fluid for fission products after the original fluid, water, has been removed.  $NaNO_3$  was found to be such a salt. Its melting point is 585°F, it flows as freely as water, and remains fluid up to 700°C. Experimental work is described on the treatment of the acid aluminum, STR, and SIR wastes by calcining. In these experiments, acid waste solutions were fed, either raw, in a neutralized state, or in an alkaline state, to a calcining apparatus. After dehydration in the calciner, the apparatus discharged either a molten salt solution



or a dry salt powder. The chemistry of the process and equipment used in the pilot plant calciner is described. Results are tabulated. Results are also reported from a study of the corrosion of 1020 mild steel, 304 SS, and 347 SS by neutralized and dehydrated samples from a number of waste streams. A cost analysis was made for processing Arco Chemical Plant wastes by various methods. Spray drying was investigated as a means of converting aqueous Arco waste solutions into dry, relatively insoluble powders. (C.H.)

**14385** CF-58-11-91

Oak Ridge National Lab., Tenn.

RECENT DEVELOPMENTS IN FEED PREPARATION AND SOLVENT EXTRACTION. F. R. Bruce, R. E. Blanco, and J. C. Bresee. Mar. 20, 1959. 67p. Contract [W-7405-eng-26]. \$10.80(ph), \$3.90(mf) OTS.

For presentation at the 5th Nuclear Congress, Cleveland, Apr. 7, 1959.

Increasing emphasis has been placed recently on the application of solvent extraction to the recovery of uranium and plutonium from spent power reactor fuels. Zircaloy-2 jackets were removed from PWR blanket-type fuels by dissolution with the Zirflex Process, and the  $\text{UO}_2$  cores were dissolved in 10 M  $\text{HNO}_3$ . Zirflex treatment of prototype samples irradiated to 2500 Mwd/ton resulted in satisfactory dissolution rates and losses to the de jacketing solution generally less than 0.2% for U and Pu. U-Zr alloy fuels were dissolved in 6 M  $\text{NH}_4\text{F}$  and adjusted for solvent extraction by the addition of  $\text{Al}(\text{NO}_3)_3$  and  $\text{HNO}_3$ . In an alternative procedure, fluoride was recycled by metathesis and precipitation. Stainless steel jackets were removed from Consolidated Edison-type fuels by dissolution in 6 M  $\text{H}_2\text{SO}_4$  (Sulfex Process), and the  $\text{ThO}_2$ - $\text{UO}_2$  core was dissolved in 13 M  $\text{HNO}_3$ -0.04 M F-0.04 M Al. De jacketing losses in unirradiated samples were about 0.02%. Use of the ORNL Reference Darex flowsheet for APPR processing resulted in solvent extraction feed containing 30 ppm chloride. Mechanical equipment was designed to de clad SRE fuel, and chop and leach techniques are being developed to treat stainless and Zr clad ceramic fuel. A solvent extraction flowsheet was developed for Foreign Research Reactor Fuels, (Al-20% enriched U alloy) using a revised tributyl phosphate extraction system for the separation of Pu from U. Feasibility tests were carried out on the coupling of Redox solvent extraction with Darex and Niflex head-end treatments. New solvents for the reprocessing of power reactor fuels are being studied. Among these, the amines show an order of magnitude greater radiation stability than does tributyl phosphate. A primary amine was proposed for the recovery of U and Pu from Sulfex de cladding wastes. (auth)

**14386** HW-41525

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DESIGN CRITERIA IN-LINE ALPHA MONITOR. N. T. Hildreth. Feb. 22, 1956. 17p. Contract [W-31-109-Eng-52]. \$3.30(ph), \$2.40(mf) OTS.

Design requirements for a Redox or Purex in-line alpha monitor for process control are given. (T.R.H.)

**14387** HW-50379

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PUREX SOLVENT WASHING WITH BASIC POTASSIUM PERMANGANATE. G. L. Richardson. May 29, 1957. Decl. May 5, 1959. 6p. Contract [W-31-109-Eng-52]. \$1.80(ph), \$1.80(mf) OTS.

Purex Plant solvents were used in studies to investigate the fission product decontamination achieved by  $\text{KMnO}_4$  scavenging of used solvent. Major variables studied were  $\text{KMnO}_4$  concentration, volume ratio, successive scrubbing, temperature, and contact times. The distribution ratio of  $\text{KMnO}_4$ , the effective life of the scavenging solution, and the results of re-using the scavenged solvent in the Purex process were measured. (J.E.D.)

**14388** HW-57582(Del.)

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

TECHNOLOGY OF NON-PRODUCTION REACTOR FUELS REPROCESSING—BUDGET ACTIVITY. Quarterly Report. V. R. Cooper. Sept. 25, 1958. Decl. with deletions Apr. 2, 1959. 11p. Contract W-31-109-Eng-52. \$3.30(ph), \$2.40(mf) OTS.

Mechanical processing activities for the period are briefly reviewed. De jacketing and dissolution studies for the Zirflex Process and Niflex Process are outlined. Redox and TBP solvent extraction studies and packed TBP solvent extraction columns are discussed. Zirflex corrosion studies are reported. Analytical developments are briefly outlined. (For preceding period see HW-56477.) (J.E.D.)

**14389** TID-3529

Technical Information Service Extension, AEC. REPROCESSING OF IRRADIATED FISSION REACTOR FUEL AND BREEDING MATERIAL. A Literature Search. James M. Jacobs, comp. May 1, 1959. 13p. \$0.50(OTS).

Selected unclassified reports on reprocessing fissile and fertile materials are listed which have been received by the Technical Information Service Extension since the preparation of TID-3312, Reprocessing of Irradiated Fission Reactor Fuel and Breeding Materials. The listing contains 119 references to unclassified reports. (A.C.)

**14390**

EXTRACTION OF PLUTONIUM AND URANIUM. U. K. Atomic Energy Authority (Canada). British Patent 801,743. Nuclear Eng. 4, 238(1959) May.

An aqueous nitric acid solution, containing fission products in addition to plutonium in the tetravalent or higher state and uranium in the hexavalent state is treated with a water-immiscible phase which includes tributyl phosphate.

## CONTROLLED THERMONUCLEAR PROCESSES

**14391** CERN-59-16

European Organization for Nuclear Research, Geneva. EUROPEAN FUSION RESEARCH. Report of the CERN Study Group on Fusion Problems. J. B. Adams. Apr. 14, 1959. 34p.

The purpose of the CERN study group was to coordinate effort on fusion problems and prevent duplication of effort. The main objectives were to exchange information on fusion research, to discuss programs being undertaken in the various laboratories, and to consider ways of facilitating fusion research work in Europe. Seven European nations are cooperating with the study group. The activities of the group are reviewed. (A.C.)

**14392** MATT-Q-6

Princeton Univ., N. J. Project Matterhorn. QUARTERLY REPORT COVERING THE PERIOD JANU-

ARY 1-MARCH 31, 1959. 47p. Contract AT(30-1)-1238. \$1.25(OTS).

Work on the B-3 stellarator is reported in which it was found that adding helical stabilizing winding, which should in theory produce complete stability, produced no discernible change on the observed pump-out rate. The statistical properties of such fluctuations as the reduction of the pump-out rate when the aperture is reduced by a limiter and the marked difference between the results on Etude (with an unbaked vacuum system) and B-3 are discussed. The B-1 device magnetic probes were used to measure fluctuations of the stellarator magnetic field. B-65 optical observations confirm that ion-cyclotron resonance waves heat primarily the outer regions of the discharge. An extensive theoretical investigation of confinement in the stellarator led to a number of basic problems in particle dynamics such as constancy of the longitudinal adiabatic invariant, which was proved to all orders. Preliminary results indicate that confinement of single particles in the stellarator geometry can be easily achieved if the magnetic and electric fields are constant in time. (For preceding period see NYO-2196.) (auth)

**14393** UCRL-8584

California. Univ., Berkeley. Lawrence Radiation Lab. A REVIEW OF HIGH-TEMPERATURE ROTATING-PLASMA EXPERIMENTS. John M. Wilcox. Jan. 1959. 26p. Contract W-7405-eng-48. \$0.75(OTS).

By means of crossed electric and magnetic fields in a geometry having cylindrical symmetry, a charged particle can be induced to rotate about the axis of symmetry. The new degree of freedom associated with this rotation may offer new possibilities for containing and heating plasmas. This paper reviews four experimental approaches that are being actively investigated: the Berkeley Homopolar device, the Los Alamos Ixion, and the Berkeley and Moscow ion-magnetron experiments. (auth)

**14394**

SOFT X-RAYS FROM A MAGNETICALLY COMPRESSED PLASMA IN SCYLLA. K. Boyer, E. M. Little, W. E. Quinn, G. A. Sawyer, and T. F. Stratton (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev. Letters* 2, 279-80 (1959) Apr. 1.

The Scylla plasma experiment employs a rapidly rising magnetic field in a cylindrical mirror geometry to heat a deuterium plasma. In such a plasma, bremsstrahlung radiation should be emitted as the fast moving electrons are deflected in the Coulomb fields of the ions. Soft x-ray emission is observed from the central plasma region of the discharge. The x rays were detected with a plastic scintillator and photomultiplier. The energy of emitted x rays was estimated by absorption measurements. (A.C.)

## CRITICALITY STUDIES

**14395** AECU-4173

Oak Ridge Gaseous Diffusion Plant, Tenn. THE USE OF CRITICALITY CODES IN NUCLEAR SAFETY CONSIDERATIONS AT THE OAK RIDGE GASEOUS DIFFUSION PLANT. C. E. Newlon. Apr. 6, 1959. 13p. (KSA-175). \$3.30(ph), \$2.40(mf) OTS.

Paper presented at Fifth Annual Industrial Nuclear Safety Conference, March 9-11, 1959, Aiken, S. C.

The experience of the ORGDP nuclear safety group with criticality codes, which includes the COBRAS,

GNU-II, and the PDQ codes, might be summarized by stating that, so far, criticality codes have proven useful in the evaluation of nuclear safety problems which otherwise would have been extremely laborious and in some cases essentially impossible without the use of simplifying assumptions which are only qualitative at best. In general, the results of the machine calculations have been in fairly good agreement with the results of critical mass experiments, certainly when the uncertainties of the basic nuclear input data are considered. Thus, it would appear reasonable to anticipate that criticality codes will play an increasingly important role, not only in nuclear safety evaluations of the ever present criticality problems in a gaseous diffusion plant, but in facilitating the continued development and improvement of criticality control criteria in general. (auth)

## GEOLOGY AND MINERALOGY

**14396** BM-RI-5474

Bureau of Mines.

EXTRACTION OF RARE-EARTH ELEMENTS FROM BASTNAESITE CONCENTRATE. Van E. Shaw. 1959. 16p.

Bastnaesite is a natural rare-earth fluorocarbonate of the cerium group that affords an abundant and high-grade source of the lighter rare-earth elements. A simple and efficient method has been developed by the Bureau of Mines for extracting rare-earth compounds from this mineral. Digesting of a flotation concentrate with sulfuric acid converts the rare-earth compounds from fluorocarbonates to sulfates. Action of the acid releases gaseous compounds of fluorine and silicon, leaving the sulfated material free of these elements; carbon dioxide from carbonate decomposition is eliminated at the same time. Calcining the sulfated material at 1,200°F renders the gangue constituents insoluble, whereas the rare-earth sulfates are left in water-soluble form. Leaching with water yields a solution of pure rare-earth sulfates. Bastnaesite could become prominent as a source of cerium-group rare-earth elements. It is rich in the light rare-earth elements and comparatively easy to process; reserves of the mineral are extensive enough to supply a greatly expanded market for many years. (auth)

**14397** RME-2044(Rev.)

Grand Junction Operations Office. Salt Lake Branch Office, AEC.

1954 EXPLORATION DRILLING IN THE BOULDER BATHOLITH, JEFFERSON AND SILVER BOW COUNTIES, MONTANA. Wayne S. Moen. Jan. 1959. 40p. \$1.25(OTS).

Three of five properties in the Boulder batholith of western Montana that were diamond drilled for uranium during 1954 are sufficiently mineralized to warrant further attention. An ore body, 15 to 30 feet long and extending to a depth of 165 feet, was delineated on the Mooney claim 10 miles west of Butte, Montana. Meta-autunite occurs disseminated in altered quartz monzonite adjacent to a quartz-stibnite vein and coats the fracture surfaces of the vein. Two siliceous reef-type structures near Alhambra, Montana, contain uranium minerals in concentrations approaching ore grade. Metaautunite and torbernite coat fracture surfaces of the chalcedonic quartz veins comprising the G. Washington structure, while disseminated pitchblende occurs at depth in the President vein. (auth)



**14398** TEM-602(Pt. I)

Geological Survey, Washington, D. C.  
**RECONNAISSANCE GEOLOGY OF PLACER DEPOSITS CONTAINING RADIOACTIVE MINERALS IN THE BEAR VALLEY DISTRICT, VALLEY COUNTY, IDAHO.**  
 J. Hoover Mackin and Dwight L. Schmidt. Jan. 1953. 31p., 2 illus. \$6.30(ph), \$3.00(mf) OTS.

A reconnaissance of the Bear Valley district was undertaken to provide a geologic interpretation of placer deposits drilled by the U. S. Bureau of Mines. The placer minerals are monazite and a group of uranium bearing rare earth columbates and tantalates here referred to loosely as radioactive blacks. The monazite is an accessory mineral in the granitic country rock; the radioactive blacks occur in pegmatite dikes. The supply of these minerals to the placers was controlled by the geography of their occurrence in the parent rock, and by the distribution of alpine glaciers during two late Pleistocene glacial stages. By reason of a favorable combination of these factors, the richest placer deposits of the district are in Big Meadow, a valley fill formed as a result of the blocking of Bear Creek by a glacier from a tributary valley during the Illinoian (?) stage. The Big Meadow fill consists of intertonguing depositional units formed by Bear Creek and its tributaries, including both normal alluvium and glacial outwash, and ranging from rich to barren. The richest phase that has been blocked out by drilling was derived from the drainage basin of Casner Creek, an east tributary of Bear Creek. The geologic relations suggest that a neighboring stream, Howard Creek, should have supplied equally rich material, but the part of the valley fill formed by Howard Creek has not been tested. The Howard Creek deposits and shallow alluvium in the upper valleys of Casner and Howard Creeks may considerably increase the reserves of the district. (auth)

**14399**

**UMOHOITE FROM THE LUCKY MC MINE, WYOMING.**  
 Robert G. Coleman and Daniel E. Appleman (U. S. Geological Survey, Washington, D. C.). *Am. Mineralogist* 42, 657-60(1957) Sept.-Oct.

A new occurrence of the hydrous uranium-molybdenum mineral umohoite is described from the Lucky Mc mine, Wyoming. X-ray investigation shows that umohoite is monoclinic,  $P2_1(C_2^2)$  or  $P2_1/m(C_{2h}^2)$ ,  $a = 14.30 \text{ \AA}$ ,  $b = 7.50 \text{ \AA}$ ,  $c = 6.38 \text{ \AA}$ ,  $\beta = 99^\circ 05'$ . Optically umohoite is biaxial negative with  $\alpha(\text{calc.}) 1.66 \pm 0.01$ ,  $\beta 1.831 \pm 0.005$ , and  $\gamma 1.915 \pm 0.005$ ,  $2V(\text{Na}) 65^\circ \pm 2^\circ$ ; pleochroism X dark blue, Y light blue, Z olive green; dispersion  $r > v$ , strong. The strongest lines of the x-ray powder pattern are  $7.31-6.96$  (broad) (100),  $3.22$  (50),  $14.10$  (25), and  $3.18$  (25). Indexed x-ray powder diffraction data are listed. (auth)

**14400**

**THE SEARCH FOR URANIUM IN HESSE.** W. Bisgiel. *Atomwirtschaft* 4, 167-72(1959) Apr. (In German)

The search for uranium in Hesse, begun in 1956, has led to no finds of economic interest, but it has indicated promising places for further exploration. (J.S.R.)

**14401**

**FIRST NATURAL OCCURRENCE OF ZEUNERITE FROM THE SECONDARY URANIUM MINERALS OF THE VAL RENDENA.** Carlo L. Garavelli and Fiorenzo Mazzi (Università, Florence). *Atti accad. nazl. Lincei Rend. classe sci. fis. mat. e nat.* 25, 75-80(1958) July-Aug. (In Italian)

During an investigation of the secondary uranium minerals in the uranium deposits of southwest Trentino,

a sample was found which appeared to be identical with zeunerite, a hydrated copper uranyl arsenate. The x-ray, spectrographic, and optical data which led to this conclusion are tabulated. The sample was not large enough for chemical analysis. (J.S.R.)

**14402**

**STUDY OF MINERAL AND SYNTHETIC URANATES.**  
 H. Potdevin and H. Brasseur (Université, Leige). *Bull. classe sci., Acad. roy. Belg.* 44, 874-912(1958). (In French)

Minerals and synthetic compounds of the formula type  $mXO \cdot nUO_3 \cdot pH_2O$ , where X represents lead, barium, strontium, or calcium and in which  $m$ ,  $n$ , and  $p$  are whole numbers were studied. The compounds of this type with a strontium base are unknown in the mineral state, and only the mineral billietite is known for barium. Fourmarierite, wolsendorfit, and curite which contain lead and becquerlite containing calcium are known in nature. A detailed study was made of natural and synthetic billietite and becquerlite and synthetic wolsendorfit. Barium triuranate and hydrated strontium triuranate, which up to the present have not been discovered naturally, were synthesized. The examination of all these compounds indicates the existence of a common framework in the structure, a framework formed by the atoms of uranium surrounded by oxygen and having a quasi-hexagonal symmetry. (tr-auth)

**14403**

**GEOLOGY OF THE RAINY DAY URANIUM MINE, GARFIELD COUNTY, UTAH.** Edward S. Davidson (U.S. Geological Survey, Tucson, Ariz.). *Econ. Geol.* 54, 436-48(1959) May.

The Rainy Day mine, in the Circle Cliffs area, Utah, is developed on a long slender pod of uranium ore. Ore is localized in siltstone of the Moenkopi formation of Triassic age, on the south edge of a channel about 3,300 feet wide by 40 feet deep that is filled with sandstone of the Shinarump member of the Chinle formation of Triassic age. Shale of the Chinle rests directly on siltstone of the Moenkopi on either side of the channel. The pod of ore is of moderately high grade,  $1\frac{1}{2}$  by 4 feet in cross section, and is continuous for a mined distance of more than 1,800 feet. Sphalerite, chalcocopyrite, pyrite, marcasite, and galena are associated with a black uranium mineral, which is probably uraninite. Semiquantitative spectrographic analyses show that lead, copper, nickel, cobalt, silver, molybdenum, zinc, yttrium, and ytterbium increase proportionately with uranium; the increase suggests that these metals were introduced by the ore-forming fluid. The deposit is on the east flank of the northwest-trending Circle Cliffs anticline. No major faults are near the mine, nor were any through-going joints noted in the deposit. Efforts to correlate the localization of the deposit with minor structures were unsuccessful. (auth)

**14404**

**AN APPLICATION OF STATISTICAL ANALYSIS TO EXPLORATION FOR URANIUM ON THE COLORADO PLATEAU.** Robert C. Bates. *Econ. Geol.* 54, 449-66(1959) May.

The literature on the Colorado Plateau uranium-vanadium deposits before 1944 includes many geologic factors that could have influenced the deposition of the uranium and vanadium ore-minerals. Maps are drawn showing the relationships between these influencing geologic factors and the ore deposits, and the data on these maps transferred, using a grid system, to record sheets. These data are then ranked and analyzed using

Spearman's coefficient of rank correlation. The units of the subdivided geologic factors that gave significantly positive correlations with the productivity of the deposits are combined graphically to show the most favorable areas. Deposits that were discovered after 1944 are compared to the outlined favorable areas to show the validity of this type of analysis as a mineral exploration tool. A little less than 78 percent of the uranium-vanadium deposits on the Colorado Plateau that were discovered in the lower part of the Morrison formation after the analysis period (pre-1944) were inside of the areas outlined by the analysis as favorable. This suggests strongly that the statistical analysis can be used as a mineral exploration tool to outline areas favorable for ore deposits. (auth)

#### 14405

URANIUM DEPOSITS IN THE DRIPPING SPRING QUARTZITE, GILA COUNTY, ARIZONA. Harry C. Granger and Robert B. Raup. U. S. Geol. Survey Bull. 1046-P. 1959. 77p., 4 illus.

The Dripping Spring is a formation in the Precambrian Apache group that crops out extensively in southeastern Arizona. Nearly all the uranium deposits in the Dripping Spring are in Gila County. This paper is primarily a progress report on studies designed to accumulate geologic data that will aid in the understanding of the localization and the genesis of uranium deposits in the Dripping Spring quartzite. (auth)

#### 14406

RADIOACTIVE RARE-EARTH DEPOSIT AT SCRUB OAKS MINE, MORRIS COUNTY, NEW JERSEY. Harry Klemic, A. V. Heyl, Jr., A. R. Taylor, and Jerome Stone. U. S. Geol. Survey Bull. 1082-B. 1959. 35p., 1 illus. \$0.50(GPO).

A deposit of rare-earth minerals in the Scrub Oaks iron mine, Morris County, N. J., was mapped and sampled in 1955. The rare-earth minerals are mainly in coarse-grained magnetite ore and in pegmatite adjacent to it. Discrete bodies of rare-earth-bearing magnetite ore apparently follow the plunge of the main magnetite ore body at the north end of the mine. Radioactivity of the ore containing rare earths is about 0.2 to 0.6 milliroentgens per hour. The principal minerals of the deposit are quartz, magnetite, hematite, albitoligoclase, perthite and antiperthite. Xenotime and doverite aggregates and bastnaesite with intermixed leucoxene are the most abundant rare-earth minerals, and zircon, sphene, chevkinite, apatite, and monazite are of minor abundance in the ore. The rare-earth elements are partly differentiated into cerium-rich bastnaesite, chevkinite, and monazite, and yttrium-rich xenotime and doverite. Apatite, zircon, and sphene contain both cerium and yttrium group earths. Eleven samples of radioactive ore and rock average 0.009% uranium, 0.062% thorium, 1.51% combined rare-earth oxides including yttrium oxide and 24.8% iron. Scatter diagrams of sample data show a direct correlation between equivalent uranium, uranium, thorium, and combined rare-earth oxides. Both cerium- and yttrium-group earths are abundant in the rare-earth minerals. Radioactive magnetite ore containing rare-earth minerals probably formed as a variant of the magnetite mineralization that produced the main iron ore of the Scrub Oaks deposit. The rare-earth minerals and the iron ore were deposited contemporaneously. Zircon crystals, probably deposited at the same time, have been determined by the Larsen method to be about 550 to 600 million years old (late Precam-

brian age). Uranium, thorium, and rare-earth elements are potential byproducts of iron in the coarse-grained magnetite ore. (auth)

## HEALTH AND SAFETY

#### 14407 AECU-4162

General Mills, Inc., Minneapolis.  
UPPER ATMOSPHERE MONITORING PROGRAM.  
Progress Report No. 6 Covering period November 1, 1958 to January 31, 1959. Report No. 1903. J. Baumstark, L. Torgeson, S. Stern, A. Schekman, and W. Zeller. May 1, 1959. 37p. Project No. 89125. Contract AT(11-1)-401. \$6.30(ph), \$3.00(mf) OTS.

Programs of research into the physical parameters involved in the collection of airborne radioactive particles and the development, fabrication, and calibration of balloon-borne particle sampling equipment to implement the precise determination of stratospheric particle concentration and particle size distribution are reported. A two-stage rectangular jet impactor which collects airborne particles by impingement on a flat plate and is designed to obtain data on size distribution was fabricated. Another device, designated as a full array impactor, serves as a particle collector when its specially configured collector blades are rotated at high speed. This impactor simplifies assessment of radioactive samples by concentrating the collected particles in the relatively small area of the collector blades. In order to develop homogeneous aerosols less than 20 millimicrons in diameter, preliminary experimental work was done with S13 bacteriophage. This phase is reported to be on the order of 10 millimicrons in size. The method of its preparation for aerosolization is described. A previously developed theoretical relationship for the collection efficiency of a fibrous filter in the diffusion regime was found to give results which are in satisfactory agreement with experimental data contained in the literature. Despite limited experimental data, it was possible to compare simultaneously taken samples from a ducted, shock-mounted, high velocity, direct-flow sampler and an unducted, non-shock-mounted, low velocity Ash Can sampler. Assayed results of the former were found to be twenty-five times greater on the basis of dpm/std ft<sup>3</sup> than the latter. Recycling of air through the Ash Can sampler is believed to be the prime cause for the observed discrepancy. An experimental method is described for determining the particle size of stratospheric radioactive debris from a double filter experiment performed at altitude. (For preceding period see AECU-3974.) (auth)

#### 14408 AECU-4164

Scripps Institution of Oceanography, La Jolla, Calif.  
LOW-LEVEL COUNTING. Interim Progress Report.  
Hans E. Suess. Aug. 15, 1958. 23p. Contract AT(11-1)-34, Project 40. \$6.30(ph), \$3.00(mf) OTS.

Progress is reported on: radiocarbon increase from artificial C<sup>14</sup> measured in a California tree; analysis of fission products from rain and snow near La Jolla and smog from St. Louis; identification of Cs<sup>134</sup> in airborne particulate matter; and a tritium measurement apparatus. A list of 27 radiocarbon dates is appended. (T.R.H.)

#### 14409 AFSWC-TR-57-29

Broadview Research Corp., Burlingame, Calif.  
BLAST SHIELDING IN COMPLEXES. A. B. Willoughby, K. Kaplan, and N. R. Wallace. Aug. 1958. 158p.



Project No. P-5730, Contract AF33(616)-3778. (AD-144535).

Results are presented of an experimental investigation of the shielding effects of city complexes on the blast loading of structures both within the complex and in the region surrounding the complex. The approach used was to expose small scale models of idealized complexes of city buildings to small high explosive charges (simulating about 140 KT weapons) and to measure building loading and shock wave characteristics at various points in and around the models. For the test conditions investigated, it was found that the shielding effects of the city complex on the shock waves were limited to the complex itself, and its immediate environs. At relatively small distances behind the complex the shock waves exhibited virtually complete recovery. Within the complex, however, significant changes in loadings were found to take place when the spacing between structures was comparable to or less than the structure height. (auth)

#### 14410 CNHW-(RP-2)

Canada. Dept. of National Health and Welfare.

Radiation Protection Div., Ottawa.

LEVELS OF STRONTIUM-90 IN CANADIAN MILK POWDER SAMPLES UP TO THE END OF DECEMBER 1958. P. M. Bird and P. G. Mar. Apr. 1959. 19p.

New data of strontium-90 in milk powder samples collected from a network of Canadian sampling sites are reported for the period April to December, 1958. It is shown that the levels are continuing to increase at about the same rate as for the previous year. In addition, the results of a special study on liquid milk samples are included. An attempt is also made to estimate from these and earlier Canadian data the expected concentration of strontium-90 in human bone at the present time resulting from the strontium-90 ingested in the average Canadian diet during the period in which measurable amounts of strontium-90 have been present in milk. It is shown that these calculations are in reasonable agreement with the very limited experimental data for Canadian bone samples and that the levels are well below those recommended as maximum permissible by the International Commission on Radiological Protection. (auth)

#### 14411 M-7102

Department of Agriculture. Soil and Water Conservation Research [Div.], Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Annual Report for Period July 1, 1955 to March 31, 1956. 13p. \$3.30(ph), \$2.40(mf) OTS.

Results are reported from studies on the behavior of various fission products in the soil and plant stages of food chains. Data are included on the competitive uptake of strontium and calcium in crops and soils, distribution factors in 10 crops grown in the greenhouse on soils with varying calcium content and strontium-calcium ratio, the relative availability to oats of natural strontium and added strontium-89, the similarity of rubidium and potassium in the soil-plant system, and reactions of cations with soils and plants. (C.H.)

#### 14412 M-7103

Department of Agriculture. Soil and Water Conservation Research [Div.], Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Quarterly Report

for Period April-June 1956. July 1956. 4p. \$1.80(ph), \$1.80(mf) OTS.

Methods are discussed for determining the percentage of available and fixed strontium-90 and the calcium content of soil samples. (C.H.)

#### 14413 M-7104

Department of Agriculture. Soil and Water Conservation Research [Div.], Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Quarterly Report for Period October-December 1956. Jan. 1957. 9p. \$1.80(ph), \$1.80(mf) OTS.

Progress is reported in studies on the chemistry of strontium in soils, the movement of radioactive ions through soils, and the absorption and translocation of fission products by plants. Data are included on the foliar entry of radiostrontium and its subsequent translocation and accumulation within various plant tissues. (C.H.)

#### 14414 M-7106

Department of Agriculture. Soil and Water Conservation Research Div., Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Annual Report for Period April 1, 1956 to March 31, 1957. Apr. 15, 1957. 31p. \$6.30(ph), \$3.00(mf) OTS.

Progress is reported in studies on the absorption and translocation of radioactive fall-out nuclides by plants and the decomposition of fall-out particles and reactions of fall-out nuclides with soil. Data are included on the fixation of strontium-90 by soils and the accumulation of fission products on plant leaves. (C.H.)

#### 14415 M-7107

Department of Agriculture. Soil and Water Conservation Research Div., Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Quarterly Report for Period July-September 1957. Oct. 1957. 8p. \$1.80(ph), \$1.80(mf) OTS.

Progress is reported in a laboratory investigation of the fixation of strontium-90 by various soil types, a study of the movement of cesium-134 in different soil types, and an experiment to determine the distribution factors for strontium and calcium in alfalfa and wheat plants. (C.H.)

#### 14416 M-7108

Department of Agriculture. Soil and Water Conservation Research Div., Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Quarterly Report for Period October-December 1957. Feb. 1958. 10p. \$1.80(ph), \$1.80(mf) OTS.

Progress is reported in studies on the chemistry and fixation of strontium in soils, the adsorption and translocation of fission products by plants, the effects of additions of  $\text{CaCO}_3$  to soil on the absorption and subsequent translocations of strontium-89 after foliar application, the fixation of strontium-90 by soil, and distribution factors for strontium and calcium in alfalfa and wheat plants. (C.H.)

#### 14417 M-7109

Department of Agriculture. Soil and Water Conservation Research Div., Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Quarterly Report for Period January-March 1958. May 1958. 8p. \$1.80(ph), \$1.80(mf) OTS.

Progress is reported in studies on the fixation of strontium-90 in the plow layer of cultivated soils, laboratory investigations of the fixation of strontium by various soil types, the adsorption of strontium on various types of soils and clays, the effect of exchangeable calcium in soils on the uptake of radiostrontium, and the yield and strontium-89 content of cowpeas grown on various soil types at several exchangeable calcium levels. (C.H.)

#### 14418 M-7110

Department of Agriculture. Soil and Water Conservation Research Div., Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Annual Report for Period April 1, 1957 to March 31, 1958. Apr. 15, 1958. 31p. \$6.30(ph), \$3.00(mf) OTS.

Results are reported from investigations on the fixation of radiostrontium by natural soil components, the adsorption of strontium by clay minerals, the removal of strontium-90 from upland land surfaces by runoff, the extent of movement of radiocesium in soils, greenhouse and growth room studies of strontium-calcium discrimination factors from soil to plant, the relationship of lime levels of acid soils to the absorption of strontium, and the effect of the degree of mixing of strontium-90 in the root zone on its uptake by plants. (C.H.)

#### 14419 M-7111

Department of Agriculture. Soil and Water Conservation Research Div., Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Quarterly Report for Period April-June 1958. Aug. 1958. 8p. \$1.80(ph), \$1.80(mf) OTS.

Progress is reported in studies on the amount of strontium-90 in runoff during the growing season from field plots located in widely separated areas, the adsorption of strontium on soils and clays, the absorption and translocation of fission products, and laboratory investigations of the fixation of radiostrontium by soils and clays of various types. (C.H.)

#### 14420 M-7112

Department of Agriculture. Soil and Water Conservation Research Div., Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Quarterly Report for Period July-September 1958. Oct. 1958. 9p. \$1.80(ph), \$1.80(mf) OTS.

Progress is reported in laboratory investigations of the fixation of radiostrontium in soils, the absorption and translocation of fission products, and field experiments on the effectiveness of crop and mulch removal for decontamination of land from radioactive fall-out. (C.H.)

#### 14421 M-7113

Department of Agriculture. Soil and Water Conservation Research Div., Beltsville, Md.

ACCUMULATION AND MOVEMENT OF FISSION PRODUCTS IN SOILS AND PLANTS. Quarterly Report for Period October-December 1958. Mar. 1959. 14p. \$3.30(ph), \$2.40(mf) OTS.

Progress is reported in studies on the decontamination of bare soil from radioactive fall-out by means of scraping, with and without application of asphalt, laboratory investigations of the fixation of radiostrontium by soils, the adsorption of calcium and strontium by clays, and the adsorption and translocation of fission products by alfalfa and wheat. (C.H.)

#### 14422 MLM-948

Mound Lab., Miamisburg, Ohio.

BIOLOGICAL DECOMPOSITION OF RADIOACTIVE LAUNDRY WASTE. E. W. Wiederhold. Mar. 10, 1954. 18p. Contract AT-33-1-GEN-53. \$0.75(OTS).

A series of tests was conducted on a laundry waste containing radioactive materials, using an activated sludge process, to determine whether the organic materials which would interfere with a process of flocculation and adsorption could be removed along with a substantial quantity of the radioactive material. A trickling filter was used to treat the waste over a long period of time. The filter removed nearly all of the activity and most of the organic compounds. However, sufficient residual activity remained in the effluent to require either two-stage operation or final processing by flocculation and adsorption. Recirculation was beneficial. A supplementary bacteria feed of ammonium nitrate was necessary. (auth)

#### 14423 NP-7533

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

GAMMA-RAY ANALYSIS OF ATMOSPHERIC DUST SAMPLES. J. L. Horwood. Sept. 23, 1958. 23p. (R-24).

Gamma-ray spectra of dust samples from the atmosphere were plotted from measurements with a five-channel analyzer. Peaks from fission products Zr-95, Nb-95, Ru-103, Ce-141, Ce-144 and Cs-137, with half-lives of several days and longer, were identified. The same peaks were found in a sample of house dust. Very long-lived fission products such as caesium-137 were not of sufficient activity to permit identification until the samples had decayed for several months. (auth)

#### 14424 NRL-5041

Naval Research Lab., Washington, D. C.

FISSION PRODUCT RADIOACTIVITY IN THE AIR ALONG THE 80th MERIDIAN, JANUARY-JUNE 1957. L. B. Lockhart, Jr., R. A. Baus, and I. H. Blifford, Jr. Oct. 1, 1957. 9p. Project Nos. NR 571-000 and Nr 571-003. (AD-150740).

Measurements of gross fission product radioactivity in the air at a number of sites along the 80th meridian (west) are reported for the period January to June 1957. The concentration of long-lived radioactive products (primarily fission products) in the air continues to remain considerably higher in the Northern than in the Southern Hemisphere. Nowhere has it approached the maximum permissible level for continuous exposure to external radiation established by the U. S. Atomic Energy Commission. Among the more interesting developments, there has been obtained a definite inverse relation between the air concentration of radioactivity and rainfall during the dry and rainy seasons at Panama. The use of radioactivity profiles (plots of latitude vs. fission product concentration) to represent a cross section of the average air concentrations of fission products along the 80th meridian for any given period offers a ready means to obtain the total burden of such activity in the atmosphere for such a period and to follow its increase or decrease with time. (auth)

#### 14425 SCTM-18-59(51)

Sandia Corp., Albuquerque, N. Mex.

FALL OF SMALL PARTICLES IN THE UPPER ATMOSPHERE. John R. Benister. Jan. 22, 1959. Decl. May 20, 1959. 9p. Contract AT(29-1)-789. \$1.80(ph), \$1.80(mf) OTS.

The altitude history of labeled debris of Hardtack



Orange shot is calculated. This calculation, which ignores vertical atmospheric transport, indicates that particulate debris should soon fall to an altitude which can be reached by existing rocket samples systems. After this initial rapid descent the fall rate decreases so the material remains at an intermediate altitude (100 to 250 kft) for a protracted period. (auth)

**14426** TID-5558

Atomic Energy Commission, Washington, D. C. and Department of Agriculture.

SOIL AND PLANT RELATIONSHIPS OF FISSION PRODUCTS. R. F. Reitemeier. May 1959. 10p. \$0.50(OTS).

Presented at the Hearings on Fallout Before the Joint Committee on Atomic Energy, May 5-8, 1959.

The fission products contained in fall-out particles enter the food chain of man primarily through plants and soils. Some particles are deposited initially on the plants, the remainder on the soil. Mechanisms of intake of fission products by plants, reactions with soils, and land reclamation and decontamination measures are discussed. (auth)

**14427** UCRL-5342

California. Univ., Livermore. Lawrence Radiation Lab.

THE RATIO OF ALPHA TO BETA ACTIVITY OF NATURAL ATMOSPHERIC RADIOACTIVITY. Carl L. Lindeken. Mar. 27, 1959. 12p. Contract W-7405-eng-48. \$3.30(ph), \$2.40(mf) OTS.

The alpha to beta ratio of naturally occurring radioactivity in the air has been investigated. The study has concerned itself primarily with radon daughter products collected on filter-paper samples from the time equilibrium has been established on the paper through elapsed times during which radioactive counting is normally accomplished. Calculations showing the change in this ratio of activities during the above period are presented. From this work it appears that the observed constancy of ratio does have theoretical justification and that departures in alpha-to-beta ratio would be a usable approach to the detection of long-lived alpha or beta radioisotopes in the atmosphere. (auth)

**14428**

CERTAIN FEATURES IN THE DEVELOPMENT OF PROGENY IN DOGS SUBJECTED TO THE ACTION OF PRODUCTS OF URANIUM FISSION. A. P. Novikova and S. P. Voskresenskii. *Med. Radiol.* 4, No. 2, 15-19 (1959) Feb. (In Russian)

The growth and development of the progeny from the affected dogs had specific features, which were characterized by retarded weight, lowered resistance to influences of the external environment, allergic nuance of the reaction to the action of inflammatory (infectious, chemical) agents, etc. In the given conditions of experiment (single introduction of products of uranium fission, 1 mc/kg) the progeny of the 4th to 6th litter from affected dogs proved more viable than the progeny of the first two litters from the same dogs. The transfer of the radioactivity from the female dog to the fetus occurs in the first, as well as in the subsequent litters, appearing in 3.5 to 4 years following the introduction of radioactive products. (auth)

**14429**

GENETIC EFFECTS OF SMALL DOSES OF IONIZING RADIATION. N. I. Shapiro (Inst. of Biological Physics, Academy of Sciences, USSR). *Med. Radiol.* 4, No. 2, 67-77(1959) Feb. (In Russian)

The genetic effects produced on humans by small doses of ionizing radiation are discussed. The problem is enhanced by the global increase of radioactivity due to the atomic and hydrogen weapons tests, medical uses in diagnostic and therapeutic treatments, and the increased number of personnel in contact with radioactive materials. A short review is given of the regularities in new hereditary mutations in plants and animals and the effects of radiation on these processes. (R.V.J.)

**14430**

METHODS OF CALCULATING RADIOACTIVE FALL-OUT. T. A. Brody, George Rickards C., and Enriqueta G. B. de Velarde (Universidad Nacional Autónoma, Mexico). *Rev. mex. ffs.* 8, 43-59(1959). (In Spanish)

Two methods of calculating  $\beta$  activity,  $\text{Sr}^{90}$  content, and infinite  $\gamma$  dose from crude fall-out data are described. The simplified method is adapted to use of desk calculators, but gives only monthly totals of strontium and  $\gamma$  dose and does not correct for decay between sampling and counting. The more complete method corrects for decay and gives individual data, but requires the use of a high-speed computer; the programming for a machine of IBM 650 type is described. Both methods require knowledge of the sample age, calculated from the known dates of explosions. The infinite  $\gamma$  dose is obtained from this by the method of Eisenbud (1956). The results given by the two methods are approximately the same. (auth)

**14431**

FOURTH REPORT ON STUDIES OF RADIOACTIVE FALL-OUT. Fernando Alba A., T. A. Brody, Adelaida Palacios, George Rickards C., Enriqueta, G. B. de Velarde, and A. M. Martínez (Universidad Nacional Autónoma, Mexico). *Rev. mex. ffs.* 8, 61-84(1959). (In Spanish)

Fall-out data for the period covering November 1957 to January 1959 for thirteen stations in the Mexican Republic, using the gummed paper method, are presented. Approximate figures for infinite  $\gamma$  doses and  $\text{Sr}^{90}$  precipitation are deduced; the latter are compared with the results obtained by radiochemical determination using the funnel method of rain-water collection. Data on  $\text{Sr}^{90}$  determination in milk and human bone are also presented. (auth)

**14432**

EFFECTS OF RADIOACTIVE MATERIALS ON ANAEROBIC DIGESTION. I. RADIOPHOSPHORUS. Werner N. Grune, Donald D. Bartholomew, and Cecil I. Hudson, Jr. (Georgia Inst. of Tech., Atlanta). *Sewage and Ind. Wastes* 30, 1123-50(1958) Sept.

Problems presented by the disposal of low-level radioactive wastes through conventional waste treatment plants are reviewed. A number of qualitative parameters was measured to evaluate the effects of radiophosphorus on anaerobic digestion of sewage sludge. Measurements were made of gas production, pH, volatile acid concentration, and solid concentration in the sludge. An effort was made to establish the distribution of radioactivity from digested sludge and to definitely establish the level at which radioactive materials such as phosphorus-32 and iodine-131, as commonly discharged into sewage plants, would exert deleterious effects on anaerobic digestion processes. Measurements were also made of the relative concentration of radioactivity between the liquid and the solid component of the sludge after treatment. 52 references. (C.H.)

**14433**

EFFECTS OF RADIOACTIVE MATERIALS ON ANAEROBIC DIGESTION. II. RADIOIODINE. Werner N. Grune, Donald D. Bartholomew, and Cecil I. Hudson, Jr. (Georgia Inst. of Tech., Atlanta). *Sewage and Ind. Wastes* 30, 1399-1410(1958) Nov.

The effects of concentrations of iodine-131 ranging from 1.0 to 100 mc/l on the anaerobic digestion of sewage sludge by microorganisms were investigated. Data are presented on rate of gas production, ultimate gas production, concentration of volatile acids, reduction of volatile matter, and pH. No significant changes were noted in the uptake of iodine-131 by the solid phase with increases in initial radioactivity up to 100 mc/l. At least 60% of the activity appeared to be concentrated in the solid phase. This degree of concentration suggests some promise of fixing a portion of radioactivity in sewage sludge solids for low-level disposal. (C.H.)

**14434**

PROCEEDINGS OF THE SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY, HELD IN GENEVA, 1 SEPTEMBER-13 SEPTEMBER 1958. VOLUME 21. HEALTH AND SAFETY: DOSIMETRY AND STANDARDS. Geneva, United Nations, 1958. 255p. \$10.50.

The work of the International Commission on Radiological Protection is reviewed. Operational experiences in health and safety in the field of radiation are discussed. Topics include dosimetry and standards, absorbed dose and radiological units, calibration of sources and counters, determinations of local radiation doses, counting techniques and equipment, high-level dosimetry using chemical and thermoluminescence methods, and neutron dosimetry. (C.H.)

## INSTRUMENTS

*Refer also to abstract 14305.*

**14435** AD-200138

Nuclear Science and Engineering Corp., Pittsburgh. DETERMINATION OF NEUTRON DOSAGE BY FOOD IRRADIATION DEVICES. Report No. 5 (Annual) [for] September 10, 1956-November 9, 1957. P. Kruger. 46p. Project No. 7-84-01-002. Contract DA-19-129-QM-741.

The neutron fluxes in food irradiation facilities of current interest to the QMFCI have been measured by detector foil activation for neutrons in three energy ranges, thermal, epithermal and fast. For spent fuel element facilities, the thermal neutron fluxes measured ranged from 7 to 1400 n/cm<sup>2</sup>sec. The epithermal neutron fluxes were correspondingly of the order of 0.5 to 12 n/cm<sup>2</sup>sec/ev, and the fast neutron fluxes were below measurable levels, < 100 n/cm<sup>2</sup>sec for energies above 2.5 Mev and < 15 n/cm<sup>2</sup>sec for energies above 8 Mev. The neutron fluxes measured are considered too low to cause detectable long-lived radioactivity in foods during sterilizing irradiation. Radioactivity measurements of unirradiated foods showed that fallout activity was small compared to the activity due to the radioactive potassium in the foods. Sr<sup>90</sup> activity was shown to be negligible compared to K<sup>40</sup> activity. Foods, irradiated to sterilization, were examined for induced radioactivity. The induced activity, determined by the difference in the total radioactivity content of irradiated foods and the total radioactivity content of similar un-

irradiated foods, was within the uncertainties of the variance of the chemical composition of No. 2 size cans of similar food and of the analytical measurements. Therefore, although conclusion of the extent of radioactivation, if any, in the sterilized foods cannot be drawn with these data, it may be stated that the quantity of induced activity is less than the amount naturally present. It is recommended that large homogeneous samples of foods be utilized in future work to obtain more statistically significant radioactivity data. (auth)

**14436** AECU-4123

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

SUGGESTION FOR AN INVESTIGATION LEADING TO THE DEVELOPMENT OF A "STEAM-QUALITY" GAGE. Henry B. Karplus, [1959?]. 14p. \$3.30(ph), \$2.40(mf) OTS.

An instrument was developed for measuring the water droplet content of steam through its relationship to the acoustic properties of the steam. The experimental work associated with this particular phase was directed toward the more immediately pressing problems of reactor safety, and measurements were made on the propagation of large-amplitude waves through boiling water. The velocity of sound varies with the water content of steam; hence, a measurement of this velocity provides a good technique for determining the water content of any given sample of steam. (J.E.D.)

**14437** AERE-Z/M-212

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

SUMMARY OF FORMULAE FOR INDUCTIVE ENERGY TRANSFER AND COMPARISON OF CIRCUITS. D. A. Watt. Dec. 1958. 21p.

Equations are given for the voltage and currents in simple parallel networks suitable for inductive energy transfer. L-C-L, L-C-R-L, and L-R-L systems with constant circuit parameters are examined and compared. Curves of the initial inductive energy stored and peak capacitor energy required are given for a range of inductance ratios and for all conditions of damping in the L-C-R-L system. It is shown that the L-C-L system offers the minimum energy requirement but utilizes more capacitor energy at the minimum condition than the alternatives. For a given energy input, however, the L-C-R-L system must be heavily damped in order to require less capacitor energy storage than the L-C-L system. In this case the transfer can be effected by an L-R-L circuit with equal inductive energy storage. In a heavily damped L-C-R-L network the capacitor may be helpful in the initial switching operation, but it does not affect either the initial energy requirement or the amount transferred. (auth)

**14438** ARF-1118-6

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

A WIDE-RANGE NEUTRON DETECTOR AND MONITORING INSTRUMENT. Final Report. K. G. Porges and C. A. Stone. Apr. 22, 1959. 47p. Contract AT(11-1)-619. \$7.80(ph), \$3.30(mf) OTS.

A proportional counter has been constructed whose cathode diameter increases towards one end. This instrument may be operated at such a combination of applied voltage, electrical gain and pulse height discrimination that, when short-range ionizing events releasing the same primary ionization occur throughout the coun-



ter, only part of the latter contributes to the measured count rate. Specifically, the voltage, at fixed electronic gain and discrimination, may be reduced with increasing irradiation, reducing the "effective" volume or cathode area of the counter to a rather small value near the narrow end; the operating range of the counter is thus increased by the ratio of full to minimum volume or cathode area. The preliminary work described in this report shows that the basic design principles of the proposed type of instrument are sound. A prototype instrument with a boron-coated graphite cathode, exponentially shaped, was built and tested extensively. Background and pile-up problems arising in the operation of such instruments are briefly discussed, and further desirable work suggested. (auth)

#### 14439 CENC-1012

Combustion Engineering, Inc. Nuclear Components Dept., Chattanooga.

#### APPLICATION OF HIGH TEMPERATURE STRAIN

GAGES. W. S. Rice, Jr. Aug. 1957. 14p. CE Contract 7954.

A technique for application of Baldwin-Lima-Hamilton HFA-2 high-temperature strain gages is presented. The method was found to be the most suitable. (T.R.H.)

#### 14440 CENC-1014

Combustion Engineering, Inc. Nuclear Components Dept., Chattanooga.

#### APPLICATION OF LOW TEMPERATURE STRAIN

GAGES. W. S. Rice, Jr. Mar. 1959. 13p. CE Contract No. 7954-14.

The attachment of paper-base and bakelite-base strain gages to a test specimen using epoxy resin cement is described. (T.R.H.)

#### 14441 GAT-T-586

Goodyear Atomic Corp., Portsmouth, Ohio.

THE HUGHES MEMOSCOPE AS A GAMMA RADIATION SPECTRUM DATA COLLECTION AND PRESENTATION DEVICE. M. E. Jacobs, May 14, 1959. 18p. Contract AT(33-2)-1. \$0.50(OTS).

Graphs of various gamma radiation spectra, taken by plotting data from a single channel pulse height analyzer, are compared with photographs of gamma radiation spectra presented on the tube face of the Hughes Memoscope Model 104. If the count rate with a 1-volt-width window is of the order of 10,000 to 100,000 counts per minute, a complete graph of the spectrum can be obtained in 10 seconds. (auth)

#### 14442 GAT-T-588

Goodyear Atomic Corp., Portsmouth, Ohio.

#### INTEGRAL CONTROL FOR AUTOMATIC BEAM-

POSITIONING IN MASS SPECTROMETERS. M. L. Hanson, Feb. 25, 1959. Changed from OFFICIAL USE ONLY Apr. 16, 1959. 16p. Contract AT(33-2)-1. \$3.30 (ph), \$2.40 (mf) OTS.

A means of controlling the position of the ion beam of a mass spectrometer with respect to the collector slit was developed. Positioning is accomplished by varying the accelerating voltage in accordance with the integral of a quantity proportional to the position error. The error is defined by the amplitude and phase of an a-c component in the collector current. A laboratory model of a control incorporating these principles was constructed and evaluated. Excellent control of beam position was achieved at no sacrifice in analytical precision. A high degree of reliability is indicated since the control was in continuous service for several months without a component failure. (auth)

#### 14443 HW-57507

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

#### A SENSITIVE GAMMA SCINTILLATION TRANSIS-

TORIZED MONITOR. W. G. Spear. Apr. 21, 1959. 13p. Contract W-31-109-Eng-52. \$0.50(OTS).

A sensitive gamma monitor was designed with a first-range full scale sensitivity of 0.015 mr/hr or 10,000 C/M. Range two and range three are 100,000 and 1,000,000 C/M, respectively. The complete instrument (including probe) weighs 17 pounds excluding the chart recorder. The instrument employs a 5-inch diameter phototube and a 5 × 5-inch NE-102 terphenyl-in-polyvinyltoluene crystal. All circuits are transistorized and are of the plug-in, unitized construction type. The instrument will drive a standard one milliampere chart recorder. The batteries employed will continuously operate the instrument for 150 hours. The complete instrument was temperature-tested from minus 20 to plus 140°F with no malfunctioning and with a reading error of about 6.0 per cent. (auth)

#### 14444 NAVORD-5698

Naval Ordnance Lab., White Oak, Md.

PROCEDURES FOR COUNTING AND HANDLING LOW ACTIVITY FOILS. Donald G. Simons. Aug. 26, 1957. 15p. (AD-143276).

In view of the possibility of gathering misleading information when determining low activities in radioactive foils, certain specific practices of foil handling and counting should be followed. The optimum time for counting activity is 1.8 half lives. The background count should be made over a period at least four times that long. Cosmic ray variation will have no measurable effect on this background. Special precautions are discussed for avoiding foil contamination and systematic errors in accumulating data from several experiments. The advantages of shielded anticoincidence counting methods are pointed out. (auth)

#### 14445 NP-7604

Naval Research Lab., Washington, D. C.

#### TRANSDUCERS FOR STRAIN MEASUREMENT IN

INTENSE RADIATION FIELDS. R. C. Smith and N. J. Rendler. 1958. 20p.

Paper No. 507 Presented at The Society for Experimental Stress Analysis [Meeting], Cleveland, May 14-16, 1958.

A need exists for transducers capable of accurately measuring strain in the presence of gamma and neutron radiations. A series of experiments is described in which high temperature type strain gages were exposed to typical reactor radiations. The results indicate that foil transducers bonded to metal specimens with ceramic cements operate satisfactorily for limited integrated neutron fluxes. (auth)

#### 14446 NP-7588

Battelle Memorial Inst., Columbus, Ohio.

PERSONNEL NEUTRON-DOSIMETRY SYSTEMS. Final Summary Report [for] March 15, 1957 to May 15, 1958. W. S. Diethorn, E. Paskell, R. K. Willardson, J. V. Moody, R. Beck, G. Lamale, J. McFarling, P. Schall, and G. D. Calkins. May 15, 1959. 45p.

Diffused-junction silicon devices have been fabricated which show measurable changes in forward current for fast-neutron exposures as low as 50 tissue rads. For 600-rad exposures the change in forward current is 50 per cent (0.5 amp). After the first 300 rads the change is about 30 per cent (300 ma). Little or none of

this change in the forward current anneals out when the irradiated devices are stored at room temperature for periods up to 2 months. Direct measurements of minority-carrier lifetime as a function of exposure show a linear dependence of reciprocal lifetime on the number of incident neutrons. The rate of change of reciprocal lifetime is found to be nearly independent of resistivity for p-type silicon of less than 40 to 50 ohm-cm resistivity. The relationship between forward current and lifetime has been approximated and shows qualitative agreement with experimental data. This qualitative agreement indicates that predictions of both device behavior and optimum device design are possible. Consequently, it should be possible to adjust the device design to obtain maximum sensitivity over total dose ranges from an estimated minimum of less than 50 tissue rads to several thousand tissue rads. Diffused-junction silicon devices show definite promise for fast-neutron dosimetry in the range of 50 to 600 rads. Dosimeter readout would consist of a single current measurement at constant voltage. A battery and meter would be required for measurements of this type. The junction device will be small and can be made self-indicating by the use of miniature electrical components. The major portion of future work on the junction devices should be the development of a prototype device for field evaluation. (auth)

**14447** NRL-0-1656

Naval Research Lab., Washington, D. C.

FIRST PARTIAL REPORT ON MAGNETIC FLAW DETECTOR; ROTATING-MAGNET TYPE OF FLAW DETECTOR. John Swoor. Oct. 3, 1940. 22p. (AD-214638).

A flaw detector for non-magnetic materials was designed and built. The characteristics of this flaw detector are summarized in a series of graphs. An estimate is made of the smallest flaw practically detectable. (auth)

**14448** NS-4

New Zealand. Dept. of Scientific and Industrial Research. Div. of Nuclear Sciences, Lower Hutt. GAS FLOW COUNTING APPARATUS. K. A. Bargh. June 24, 1958. 18p.

A complete counting apparatus for the counting of alpha particles from powdered rock samples is described. A windowless gas flow counter is used, operating in the proportional region. Sample changing and preflushing systems are included in the mechanical assembly. The three channel electronic counter has provision for energy discrimination and can operate at counting speeds of up to 12,000 counts per minute in each channel. (auth)

**14449** ORNL-2724

Oak Ridge National Lab., Tenn.

A STUDY OF CAVITY IONIZATION AS A FUNCTION OF ATOMIC NUMBER BY USE OF A MINIATURE COUNTER. W. D. Dillow, J. A. Auxier, and R. D. Birkhoff. June 18, 1959. 66p. Contract W-7405-eng-26. \$1.75(OTS).

The response of a new type gamma counter which is insensitive to fast neutrons is obtained as a function of counter voltage, counter gas, and cathode material. The counter is a 0.5 cm x 0.5 cm right cylinder filled with isobutane at a pressure of 1.5 mm of Hg. (W.L.H.)

**14450** SC-2324(TR)-I

Sandia Corp., Albuquerque, N. Mex.

A STUDY OF THE ACCURACY AND RELIABILITY OF

COMPOUND CIRCUITS. R. J. Buehler. May 13, 1952. 22p. Contract [AT(29-1)-789]. \$4.80(ph), \$2.70(mf) OTS.

As a basis for comparing various compound circuits the following quantities are considered: the number of independently operating components, the standard deviation of circuit errors, the mean operating time of the circuit, and the reliability against duds and premature detonations. These quantities are tabulated for some simple networks, and an optimum many-component network is discussed. Some illustrations are given to show how the tabulated data may be used to select a circuit when component errors and component reliabilities are known. (auth)

**14451** SCTM-186-59(14)

Sandia Corp., Albuquerque, N. Mex.

THE THEORY AND DESIGN OF THE TRIGGERED SPARK GAP. T. J. Williams. May 22, 1959. 191p. Contract [AT(29-1)-789]. \$3.00(OTS).

The basic theory of operation of the triggered spark gap is established, and qualitative and quantitative engineering design data are given. From the basic two-electrode gap, a three-electrode or triggered gap model is established with its static and dynamic triggering characteristics shown. Several geometry conditions such as gap spacing, trigger electrode hole size, and insulator effects are discussed, showing their influence upon the triggering mechanism. A suggested trigger mechanism is given based on that proposed by Sletten and Lewis for the trigatron and modified to fit the present analysis. (auth)

**14452** UCRL-5301(Rev. 1)

California. Univ., Livermore. Lawrence Radiation Lab.

AUTOMATIC COUNTING AND RECORDING ON IBM PUNCH CARDS OF RADIOACTIVE DECAY DATA. E. A. Lafranchi, G. G. Nelson, R. L. Swenson, R. C. Kaifer, and J. J. Howland. Dec. 8, 1958. 30p. Contract W-7405-eng-48. \$1.00(OTS).

Data from 25 radiation counters are automatically punched on cards acceptable by an electronic computer. Counters run for integral minutes. At the end of the minute during which a preset number of events is accumulated, the counter stops, the system scanner connects the punch to that counter's storage unit to punch out counter and sample number, running time, number of scalers and scaling factor. Date and time come from a single 8-digit decimal clock. Some counters require manual sample changing, but the system includes automatic changers. A Hevimet ram lifts samples from a turntable into a lead shield. (auth)

**14453** WADC-TR-56-281 and Suppl. 1

Wayne Engineering Research Inst., Detroit.

DESIGN METHODS FOR MAGNETIC AMPLIFIERS AND SATURABLE REACTORS. James R. Walker and Max Frank. May 22, 1956. 628p. Supplement: Mar. 4, 1957. 63p. Project title: IMPROVED ELECTRONIC COMPONENTS. Contract AF33(616)-217.

This report and supplement, issued separately, but cataloged as a unit, may be further identified as AD-110431 and AD-130866, respectively.

A Design Manual for magnetic amplifiers describing various design methods for the standard magnetic amplifier circuits is presented. The step by step procedures are especially intended for the inexperienced designer in the magnetic amplifier art. The basic full-wave circuits of the center-tap, doubler, and bridge



connections are considered, in addition to some of the more recent half-wave circuits. The first portion of the Manual is concerned with the theory of operation of each of the various circuits, describing the function of the core and rectifier components and the effects of their properties upon amplifier response. Also, included in this section are discussions of the problems of stability resulting from a variance of environmental factors, amplifiers in cascade, and various types of loads together with some of the techniques of compensation. The second part contains the design procedures for the different circuits including examples. Designs with core configurations of toroids, U laminations, and C cores are described. Materials of construction for magnetic amplifiers form the last part of the Manual. Magnetic cores, rectifiers, wires, insulations, and encapsulation and potting materials are discussed. Testing procedures, matching techniques, and some of the characteristics of these materials are also included. The appendices contain the theoretical analyses that form the basis for the design relationships contained in the Manual. (auth)

**14454** WADC-TR-57-667

Johnston (Herrick L.) Inc., Columbus, Ohio.  
HIGH TEMPERATURE X-RAY DIFFRACTION CAMERA. [Period covered] March 1956 to July 1957. Oct. 31, 1957. 20p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: PHYSICAL ANALYSIS. Contract AF33(600)-32214. (AD-150801).

A high-temperature furnace was designed for simple attachment to a Norelco diffractometer. The furnace is constructed so as to permit x-ray-diffraction studies of solid or powder specimens at temperatures up to 1800°C in vacuum or under pressures of 2 atmospheres or less. Scanning from 2θ of 20° to 122° is possible. Heating elements are made of 0.005 inch tantalum and temperature is measured by a Pt-(87% Pt, 13% Rh) thermocouple or by an optical pyrometer. Temperatures up to 1600°C are automatically controlled to within ±0.1%. Automatic control is also possible from 1600° to 1800°C. Measurements of the lattice parameters of tantalum at various temperatures, including 1800°C, were in agreement with previously published values. (auth)

**14455** WAPD-TH-382

Westinghouse Electric Corp. Bettis Plant, Pittsburgh. HOTCHA I AND II THERMOCOUPLE RESPONSE TESTS. R. Masnovi and R. J. Melhado. [Aug. 1958]. 24p. \$4.80(ph), \$2.70(mf) OTS.

Attached to this report is a letter (WAPD-TH-398) containing pertinent data, from S. J. Green, dated Aug. 8, 1958. 1p.

A step function generator immersion apparatus was designed, built, and used successfully to produce a step change in temperature with good reproducibility. With this immersion apparatus, the time response characteristics of thermocouples both bare and also inserted in thimbles when subjected to a step increase in temperature were determined. The apparatus and the immersion fluids used (water and liquid metal) were chosen as the most practical means of closely simulating the conditions to which the prototype HOTCHA thermocouples would be subjected in the operating reactor. The range of average response times, corresponding to 63.2% of the total change in temperature, for all of the thermocouples tested are tabulated. The thermal resistance of the contact between the thermocouple

and the thimble greatly determines the over-all response time of the system. The medium into which the system is immersed, however, appears to have little effect on the system over-all response. Transfer functions have been developed and may be employed together with convolution integrals assuming linear response of the system to estimate thermocouple input when reducing inpile transient data. (auth)

**14456** WT-1509

Division of Biology and Medicine, AEC.  
REMOTE RADIOLOGICAL MONITORING. S. C. Sigoloff and H. M. Borella. Nov. 1958. 89p. Project 39.9 [of] OPERATION PLUMBBOB. \$2.25(OTS).

A gamma-radiation telemetering system was utilized to measure fall-out levels at the Nevada Test Site. Two methods of signal transmission were used: direct-coupled field lines for on-site installations and commercial telephone lines for areas out to 330 miles. Graphic and tabular data cover on-site and off-site residual gamma-radiation dose rate measurements taken as a function of time after selected events. (auth)

**14457** AEC-tr-3628

UTILIZATION OF NUCLEAR RADIATION IN THE CONTROL AND AUTOMATION OF TECHNOLOGICAL PROCESSES IN THE USSR. (Využití Jaderného Záření v SSSR při Kontrole a Automatizaci Technologických Procesů.) N. N. Sumilovskij and L. V. Meltcer. Translated from *Jaderna Energie* 4, 45-56(1958). 37p. \$6.30(ph), \$3.00(mf) JCL or LC.

A survey of progress in the USSR in the field of radiation applications to automatic control is presented. Soviet industry developed original methods and instruments based on radioactivity. Ways to extend the present uses as well as methods of research and development of new systems are discussed. It is concluded that only the solution of the entire group of problems will satisfy the task requirements as set up by the Twentieth Congress of the CPSU. (J.R.D.)

**14458** AEC-tr-3701

INCREASING THE EFFICIENCY OF IONISATION AND PROPORTIONAL COUNTERS. Ye. [E.] P. Ovchinnikov and S. S. Semenov. Translated from *Pribory i Tekh. Ekspt.*, No. 4, 39-43(1957). 10p. \$1.80(ph), \$1.80(mf) JCL or LC.

A stable electronic circuit was developed for compensating the capacitance of ionization chambers and proportional counters. Application of this provides a reduction in the equivalent input over a range of frequencies amounting to some Mc/s. In this way there is an increase in the level of signals taken from radiation detectors, together with higher resolving power and a number of fresh possibilities in the investigation of radiations. (J.R.D.)

**14459** CEA-tr-R-645

NOUVEAUX SCINTILLATEURS LIQUIDES. (New Liquid Scintillators.) Kh. V. Protopopov, Kh. A. Arslanov, S. V. Butomo, and T. V. Timofeeva (Tomofeeva). Translated into French by B. Vinogradoff from *Pribory i Tekh. Ekspt.* No. 2, 24-8(1958). 14p.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 16583.

**14460** IGRL-T/R-62

HOT CELLS. C. Cesarano. Translated by B. Rigby (U.K.A.E.A., Risley) from *Energia nucleare (Milan)* 4, 267-82(1957). 22p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 120.

**14461**

CONTRIBUTIONS TO THE DECAY OF  $\text{Tb}^{160}$  TO  $\text{Dy}^{160}$ . G. Bäckström, J. Lindskog, O. Bergman, E. Bashandy, and A. Bäcklin (Inst. of Physics, Uppsala, Sweden). Arkiv Fysik **15**, 121-9(1959).

The spectra of conversion electrons and photoelectrons have been re-investigated with high resolution and accuracy. Four new transitions have been found. Their intensities are given as well as their multipolarities. Coincidence measurements have been carried out between the different beta branches and the most prominent conversion lines. It was possible to decide between two different decay schemes that have been proposed earlier. The possible existence of an odd parity vibrational band ( $K = 0$ ) is discussed. (auth)

**14462**

GAMMA RAYS FROM THE 7.6 Mev STATE OF  $\text{O}^{15}$ . Eskil Möller (Univ. of Lund, Sweden). Arkiv Fysik **15**, 251-6(1959).

The gamma rays from the 7.55-Mev state of  $\text{O}^{15}$ , produced by proton bombardment of  $\text{N}^{14}$ , have been studied with a scintillation spectrometer. The three modes of de-excitation through intermediate levels have been confirmed by coincidence measurements. The energy values obtained for these levels are  $5.16 \pm 0.04$ ,  $6.15 \pm 0.03$ , and  $6.77 \pm 0.02$  Mev. No asymmetry of the photopeak of the 2.39-Mev gamma ray, indicating a splitting of the 5.16-Mev level, could be observed. (auth)

**14463**

NEUTRON-DEFICIENT POLONIUM ISOTOPES FROM NEON ION BOMBARDMENT OF WOLFRAM. H. Atterling, W. Forsling, and B. Aström (Nobel Inst. of Physics, Stockholm). Arkiv Fysik **15**, 279-88(1959).

In a series of experiments, cyclotron-accelerated neon ions have been used to bombard different kinds of wolfram targets. The alpha activities of the reaction products have been studied. Several neutron-deficient polonium isotopes were found, one of which was assigned to  $\text{Po}^{196}$ . The half life was determined to be 1.8 minutes, and the alpha particles emitted had an energy of 6.13 Mev. An activity with a half life of 0.5 minutes and alpha-particle energy of about 6.23 Mev has also been observed. This activity is probably identical with the one earlier assigned to  $\text{Po}^{195}$ . Decay data of some neutron-deficient polonium isotopes have been redetermined. (auth)

**14464**

PHOTO ALPHA REACTIONS IN SILVER. J. P. Roalsvig, R. N. H. Haslam, L. D. Skarsgard, and E. E. Wuschke (Univ. of Saskatchewan, Saskatoon, Can.). Can. J. Phys. **37**, 722-9(1959) June.

The reaction  $\text{Ag}^{109}(\gamma, \alpha)\text{Rh}^{105}$  has been investigated by using the secondary activity of  $\text{Rh}^{105}$ . Statistical theory was used to obtain information about the reactions  $\text{Ag}^{107}(\gamma, \alpha)\text{Rh}^{103}$  and  $\text{Ag}(\gamma, \alpha)\text{Rh}$ . The present values for the absolute yield and cross section are in agreement with previous work using either the secondary activity or photographic plates. (auth)

**14465**

SPINS OF EXCITED STATES OF  $\text{Os}^{188}$ . W. J. King and M. W. Johns (McMaster Univ., Hamilton, Ont., Can.). Can. J. Phys. **37**, 755-74(1959) June.

Seven excited states of  $\text{Os}^{188}$  populated through the beta decay of  $\text{Re}^{188}$  have been studied by gamma-gamma

angular correlation experiments. The data for the various cascades fit the following theoretical functions: (all gamma-ray energies are in kev and the description following each cascade refers to the first transition) 478-155 (2-2-0, 99.7% E2,  $\delta + ve$ ), 931-155 (0-2-0), 672-633 (2-2-0), 97% M1,  $\delta - ve$  or 3-2-0, 94% M1,  $\delta - ve$  or conceivably 4-2-0, 828-633 (2-2-0, 98% M1,  $\delta - ve$  or conceivably 3-2-0, 80% M1,  $\delta - ve$ ), 1132-633 (0-2-0), and 1308-633 (2-2-0, 98% M1,  $\delta - ve$ ). Some attenuation occurred in the correlations involving the 155-kev gamma ray. The K-conversion coefficients for the 478- and 633-kev transitions have been measured as  $0.023 \pm 0.003$  and  $0.010 \pm 0.002$  respectively, confirming the E2 character for these transitions obtained by angular correlation. These results, coupled with data concerning log ft values and gamma-ray intensities, lead to the following spin and parity assignments for levels in  $\text{Os}^{188}$ : 155 (2+), 633 (2+), 1086 (0+), 1306 (2+ or 3+), 1461 (2+), 1765 (0+), 1941 (2+), and 1958 (1+ or 2+). The 631-137 correlation data in  $\text{Os}^{186}$  were found to fit an attenuated 2-2-0 function with the first transition 99% E2 and  $\delta - ve$ . This result supports the established decay scheme for this nucleus. (auth)

**14466**

TRANSISTOR AMPLIFIERS FOR REACTOR CONTROL. E. J. Wade and D. S. Davidson (General Electric Co., Schenectady, N. Y.). Electronics **32**, No. 21, 52-3 (1959) May 22.

A logarithmic and period amplifier is described. The unit is transistorized except for log diodes and electrometers. (T.R.H.)

**14467**

RADIOACTIVE SOURCES. W. Harrison Faulkner, Jr. (Tracerlab, Inc., Waltham, Mass.). Electronics **32**, No. 21, 57(1959) May 22.

The characteristics of radioactive materials available for use in noncontacting thickness gages are tabulated. (T.R.H.)

**14468**

ELECTRONIC INSTRUMENTS IN NUCLEAR POWER REACTORS. Harold Soisson (Knolls Atomic Power Lab., Schenectady, N. Y.). Electronics **32**, No. 24, 62-3(1959) June 12.

Control, survey, and coolant monitoring instruments for reactors are tabulated with characteristics, cost, and applications. (T.R.H.)

**14469**

ELECTRIC CIRCUITS OF AN ELECTROMAGNETIC ISOTOPE SEPARATOR. A. Neyron (Centre d'Études Nucléaires, Saclay, France). Inds. atomiques **3**, No. 3/4, 65-74(1959). (In French)

The principles of operation of an electromagnetic separator are briefly reviewed. The main electrical or electronic difficulties inherent in a laboratory apparatus are discussed. The Saclay electromagnetic separator is briefly considered, and parts of the apparatus are described in some detail. (J.S.R.)

**14470**

HIGH VOLTAGE ELECTRON GUN. N. M. Popov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz. **23**, 494-500(1959) Apr. (In Russian)

Descriptions are given of the construction and specifications for an electron gun with acceleration voltage over 100 kv. Electron guns with V-shaped cathodes made of tungsten wire, developed while investigating the



luminescence system for electron microscope, with acceleration of 400 kv are also described. (R.V.J.)

#### 14471

GEIGER COUNTER HODOSCOPE WITH AUTOMATIC TESTING. H. S. Murdoch and H. D. Rathgeber (Univ. of Sydney). *J. Sci. Instr.* **36**, 209-11(1959) May.

A multi-channel Geiger counter hodoscope is described which records automatically on punch cards, uses a simple but effective quenching circuit, and contains a testing circuit. An automatic hourly test is applied to all channels, providing a random sample of their behavior and enabling speedy detection of faults either in the counters themselves or the associated recording circuits. (auth)

#### 14472

MONITORED GEIGER COUNTER X-RAY DIFFRACTOMETER WITH AUTOMATIC RECORDING. E. R. Pike and J. W. Hughes (University Coll., Cardiff, Wales). *J. Sci. Instr.* **36**, 212-23(1959) May.

The equipment produces automatically a compact photographic record of a step-scan of a powder diffraction pattern in steps of  $0.02^\circ$  ( $2\theta$ ). It is arranged that movement over the background region between lines is rapid, so that only the line profile and the immediate background on either side are recorded in detail. The specialized electronic circuits and the relay-operated automatic sequence control circuits are described, together with a special automatic camera provided with various safety devices to protect the record. Facilities for other scanning procedures are also provided. (auth)

#### 14473

HIGH-RESOLUTION NUCLEAR RESONANCE APPARATUS. J. B. Leane, R. E. Richards, and T. P. Schaffer (Physical Chemistry Lab., Oxford). *J. Sci. Instr.* **36**, 230-3(1959) May.

A nuclear resonance spectrometer for observing high-resolution spectra of hydrogen and fluorine resonances is described. The spectrometer is of extremely simple design but its stability and resolving power is approximately  $1$  in  $10^8$  when using samples of diameter approximately 5 mm. A thermally-lagged permanent magnet is used to provide the main magnetic field and a simple bridged-T spectrometer is used. (auth)

#### 14474

AUTOMATIC CORRECTION FOR PARALYSIS IN GEIGER COUNTING. R. Hunt (Radiobiological Research Unit., Harwell, Berks, Eng.). *J. Sci. Instr.* **36**, 236-7(1959) May.

A simple and inexpensive attachment to a standard probe and scaler unit is described which provides an automatic correction to the scaler reading in radioactive assays using Geiger counters. Over the usual range of operation of these counters, 0 to 16,000 impulses/min, the relative errors in the scaler reading due to paralysis of the counting system are thus reduced to 0.3%. (auth)

#### 14475

OPTICAL JOINT FOR HORIZONTAL MOUNTING OF A LARGE SCINTILLATION CRYSTAL. G. L. Olde and E. Brannen (Univ. of Western Ontario, London, Can.). *J. Sci. Instr.* **36**, 244-5(1959) May.

The preparation of the optical contact was carried out as follows. A thin layer of silicone oil was spread on the contact surfaces and an O-ring was placed in position. A press fit was made between the contact surfaces while the crystal-phototube unit was maintained in a vertical position. The latex band was snapped into position

and the edges fastened to the crystal and the photomultiplier with electrical tape. The assembly was placed in the spectrometer chassis and a constant pressure exerted between the crystal and the phototube by means of a clamping device. A small hole was cut in the uppermost surface of the latex band and silicone oil poured in until the space between the crystal and the phototube was completely filled. This arrangement has shown no leakage over a six-month period and the optical contact efficiency has remained substantially the same. (D.E.B.)

#### 14476

RADIOGRAPHY WITH A LARGE COBALT 60 SOURCE. Victor G. Behal (Dominion Foundries and Steel, Ltd., Hamilton, Ont., Can.). *Nondestructive Testing* **17**, 172-6(1959) May-June.

The use of a large  $\text{Co}^{60}$  source for the radiography of various steel shapes is reported. (W.L.H.)

#### 14477

A MICROSCOPE FOR THE SCANNING OF NUCLEAR RESEARCH EMULSIONS. A. G. Ekspong and B. E. Ronne (Inst. of Physics, Uppsala). *Nuclear Instr. & Methods* **4**, 129-32(1959) Apr.

A microscope which can handle rather large plates is described. The area which can be reached without moving the plate is  $25 \times 15$  centimeters. The largest plate which can be examined on the microscope must have one side less than 49 centimeters. The use of the microscope is made comfortable by suitably constructed manual controls. The stage can be moved rapidly and precisely. (auth)

#### 14478

REMARKS ON A RAPID 20-CHANNEL PULSE ANALYZER. M. Bonitz and E. J. Berlowitsch (Leningrad Inst. of Physics and Tech., Academy of Sciences, U.S.S.R.). *Nuclear Instr. & Methods* **4**, 133-9(1959) Apr. (In German)

A high-speed twenty-channel pulse analyzer of the Gatti type with a resolution better than  $1 \mu\text{sec}$  is described. Improved discriminators allow the introduction of a new method for increasing the practical number of channels to a multiple of twenty. (auth)

#### 14479

A SCINTILLATION COUNTER WITH NEUTRON AND GAMMA-RAY DISCRIMINATORS. F. D. Brooks (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). *Nuclear Instr. & Methods* **4**, 151-63(1959) Apr.

Certain organic scintillators, notably anthracene, stilbene and quaterphenyl crystals and oxygen-free liquid scintillators, show an effectively longer scintillation decay time for heavily ionizing particles such as alpha-particles or protons than for electrons. A scintillation counter is described which distinguishes fast neutrons from gamma-rays by means of the different decay times of recoil proton and Compton electron scintillations, respectively. Measurements of the proton-electron resolution for different scintillators are described. It is found, for example, that using a one-inch thick stilbene crystal, 2 Mev neutrons may be detected with 9.5% efficiency while the detection efficiency for 2 Mev gamma-rays is reduced by decay time discrimination to less than 0.007%. An application of the counter for fission cross section measurements by fission neutron detection is described. The decay time properties of the scintillators are discussed and the longer decay time for protons (or alpha-particles) is interpreted in terms of slow ( $10^{-7}$  sec) ion recombina-

tion processes in the scintillators; these processes produce a slow component in the scintillation decay and in a proton scintillation the proportion of slow component is more than in an electron scintillation. (auth)

**14480**

A PULSE-HEIGHT STORAGE CIRCUIT OF HIGH STABILITY. K. W. Ogilvie and D. Paix (Univ. of Sydney). *Nuclear Instr. & Methods* **4**, 164-6(1959) Apr.

A stable circuit suitable for long time storage of the height of negative microsecond pulses is described. The gain stability and linearity are better than one percent over periods of several weeks. Performance data are presented. (auth)

**14481**

THE RESPONSE TO HIGH-ENERGY GAMMA RAYS OF A NaI(Tl) SCINTILLATION SPECTROMETER. J. Kockum and N. Starfelt (Univ. of Lund). *Nuclear Instr. & Methods* **4**, 171-80(1959) Apr.

The pulse-height distributions produced by monoenergetic gamma rays in two NaI(Tl) spectrometers with diameters of 12.7 cm and lengths of 10.2 and 20.4 cm, respectively, were studied. The gamma rays were obtained from a  $\text{Na}^{22}$  and a Po-Be source (1.28 and 4.43 Mev, respectively) and from the following proton induced reactions  $\text{F}^{19}(\text{p}, \alpha \gamma) \text{O}^{16}$  (6.14 Mev);  $\text{B}^{11}(\text{p}, \gamma) \text{C}^{12}$  (11.7 Mev);  $\text{Li}^7(\text{p}, \gamma) \text{Be}^8$  (17.6 Mev); and  $\text{T}(\text{p}, \gamma) \text{He}^4$  (20.3 Mev). Measurements were performed with cylindrical lead collimators of diameters ranging from 2.5 to 17 cm. The variation of the shape of the response function with photon energy is shown to be rather small, thus permitting interpolation and extrapolation towards higher energy. A response function matrix covering the range from 4 to 34 Mev was constructed for the large spectrometer, using the pulse-height distributions obtained in this investigation and the 31 Mev distribution of Koch and Wyckoff. The inverse matrix was computed and used to compare an experimental bremsstrahlung spectrum from a 30 Mev synchrotron with a theoretical one. Good agreement was obtained. (auth)

**14482**

THE TOTAL GAMMA-ACTIVITY OF  $\text{U}^{235}$  FISSION PRODUCTS. V. N. Sakharov and A. I. Malofeev. *Reactor Technol.* **1**, 50(1959) Apr.

This paper was previously abstracted from the original language and appears in *NSA*, Vol. 12, as abstract No. 9545.

**14483**

TECHNIQUES OF GAMMA RADIATION SPECTROMETRY BY SCINTILLATION COUNTERS. Cl. Brooke. *Rev. M.B.L.E.* **2**, 33-63(1959) Jan. (In French)

A survey of the principles of gamma spectrometry by scintillation counters is followed by a brief description of counting devices developed by Manufacture Belge de Lampes et de Materiel Electronique, S. A. The conditions for the excitation and analysis of gamma spectra are discussed with an emphasis on the conditions yielding the best experimental results. A few examples are given. 32 references. (auth)

**14484**

HEALTH PHYSICS INSTRUMENTATION FOR NUCLEAR REACTOR INSTALLATIONS. Cl. Brooke and R. Schayes. *Rev. M.B.L.E.* **1**, 177-93(1958) July. (In French)

After a brief summary of the properties of nuclear radiations and their biological effects, the safety conditions and the different types of measurements neces-

sary for health physics control are studied. A survey of the instrumentation necessary is made. 17 references. (auth)

**14485**

SIMPLE PULSED NEUTRON SOURCE BASED ON CROSSED-FIELD TRAPPING. James D. Gow and Lawrence Ruby (Univ. of California, Berkeley). *Rev. Sci. Instr.* **30**, 315-17(1959) May.

A simple pulsed neutron source was constructed which consists of an anode formed by a cylindrical-shell permanent magnet and of two disk cathodes. One of the cathodes forms the neutron-producing target and the device is exhausted adjacent to the other. In operation, the anode is pulsed positive at 140 kv for 1  $\mu\text{sec}$  at up to 200 pulses per sec. Continuous operation has also been achieved in a slightly different configuration. Ions are produced adjacent to the anode in a toroidal trapping region which exists as a result of the crossed electric and magnetic fields. The ionization is enhanced by the action of electrons reflecting through the inside of the magnetic shell. As a consequence of this trapping, large fluxes of soft x-rays are created which may be injurious to personnel. (auth)

**14486**

USE OF OPERATIONAL AMPLIFIERS IN PRECISION CURRENT REGULATORS. Karl Eklund (Columbia Univ., New York). *Rev. Sci. Instr.* **30**, 328-31(1959) May.

The design and construction of precision current regulators are simplified by the use of commercially available operational amplifiers. Their method of use is described and an example is given of a regulator used with an electron spectrometer, where the regulation obtained was 0.01%. It is felt that the use of operational amplifiers offers a great convenience to the physics laboratory. (auth)

**14487**

USE OF OPERATIONAL AMPLIFIERS IN ACCELERATOR BEAM CONTROL SYSTEMS. Karl Eklund (Columbia Univ., New York). *Rev. Sci. Instr.* **30**, 331-2(1959) May.

A method of using operational amplifiers in beam control systems is described. A basic preamplifier is used with various output stages to control beam energy and position by magnetic and electrostatic means. The use of commercially available operational amplifiers provides great advantages in simplifying design, construction, and maintenance. (auth)

**14488**

PERMANENT MAGNET FOR ATOMIC BEAM FOCUSING. R. L. Christensen and D. R. Hamilton (Princeton Univ., N. J.). *Rev. Sci. Instr.* **30**, 356-8(1959) May.

A compact six-pole permanent magnet useful for focusing of atomic beams is described, together with the equations of motion of atoms in its field as used in its design. The method of construction, magnetization, and measurement of its field are discussed. (auth)

**14489**

IMPROVED DESIGN FOR HALOGEN-QUENCHED END-WINDOW GEIGER COUNTERS. K. van Duuren and J. Hermesen (Philips' Research Labs., Amsterdam). *Rev. Sci. Instr.* **30**, 367-8(1959) May.

An improved design for halogen-quenched end-window Geiger counters is described in which some of the disadvantages of the conventional end-window counter tube are overcome. The anode in the new design is made spherical or hemispherical. Comparison of the plateau



characteristics of the improved counter with the older model demonstrates the improved characteristics. (A.C.)

#### 14490

PROPOSED GEOMETRY FOR AN X-RAY CAMERA. Dwight W. Berreman (Univ. of Oregon, Eugene). Rev. Sci. Instr. **30**, 368-9(1959) May.

A device with which polychromatic x radiation from a large field might be imaged and monochromatized by diffraction from a distorted crystal is described. Preliminary computations indicate that the device might be made to yield greater optical speed and much higher spectral resolution than could be obtained from a reasonably well-filtered pin-hole camera of equivalent angular resolution. (A.C.)

#### 14491

LOW-BACKGROUND TUNGSTEN FILAMENTS FOR SURFACE IONIZATION MASS SPECTROSCOPY. J. W. Frazer, R. P. Burns, and G. W. Barton (Univ. of California, Livermore). Rev. Sci. Instr. **30**, 370-1(1959) May.

A problem encountered in high-sensitivity solid-sample mass spectroscopy when using a multiple filament ionization source in the presence of a number of unusual background peaks. Investigators think that polymer ions of potassium cause the most important of these peaks. A method is described for producing tungsten filaments from which it has been possible to detect these ions. The basic method consists of decomposing tungsten hexacarbonyl vapor on a tantalum blank at a temperature high enough to vaporize the tantalum backing from the deposited tungsten. Tungsten filaments containing less than 20% residual tantalum are produced by this means. (A.C.)

#### 14492

LINEAR GATE OF 20- $\mu$ SEC DURATION. E. L. Garwin (Univ. of Chicago). Rev. Sci. Instr. **30**, 373-4(1959) May.

The linear gate circuit described utilizes a pair of diodes as the gating elements. Similar circuits have previously been used for gates, but stored charge effects in the diodes have limited them to gate durations of about 500  $\mu$ sec or more. Recently diodes have become available which have 6- $\mu$ sec recovery time and a back-voltage rating of 15 v. These allow the construction of linear gates with durations as short as 20  $\mu$ sec. (A.C.)

#### 14493

TIME TO PULSE-HEIGHT CONVERTER. John V. Kane (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr. **30**, 374-5(1959) May.

The operation of a time to pulse-height converter circuit is described. Other time analyzers appearing in the literature are multichannel devices made to cover a specific time interval. This circuit, when used with a standard multichannel pulse-height analyzer, performs the same functions and in addition allows for easy adjustment of the time ranges. (A.C.)

#### 14494

SPIRAL CAPILLARY PLASTIC SCINTILLATION FLOW COUNTER FOR BETA ASSAY. B. L. Funt and A. Hetherington (Univ. of Manitoba, Winnipeg, Can.). Science **129**, 1429-30(1959) May 22.

Tracer counting of beta emitters in aqueous solution was performed with a detector fabricated from a plastic scintillator capillary. The detector exhibits low gamma background and reproducible detection efficiency, and it

requires minimum sample preparation. Counting efficiencies were determined for aqueous solutions of  $P^{32}$ ,  $Na^{22}$ , and  $C^{14}$  and for  $C^{14}O_2$  gas. (auth)

#### 14495

He<sup>3</sup> CRYOSTATS. V. P. Peshkov, K. N. Zinov'eva, and A. I. Filimonov (Inst. of Problems in Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1034-7(1959) Apr. (In Russian)

An apparatus is described with which temperatures below 1°K can be attained and maintained by pumping out He<sup>3</sup> vapor. Temperatures down to 0.3°K were obtained in a transparent glass apparatus possessing a volume of about 1 cm<sup>3</sup>. In a metallic, continuously operating apparatus containing 140 cm<sup>3</sup> of liquid He<sup>4</sup> a temperature from 0.5°K and higher was maintained with a heat conduction of  $7 \times 10^{-4}$  W. (auth)

#### 14496

LIQUID FLOW METERS. L. R. Blake and British Thomson-Houston Co., Ltd. British Patent 802,017. Nuclear Eng. **4**, 238(1959) May.

The flow meter described is designed for measuring the rate of flow of an electrically conductive liquid such as liquid metal in an enclosed duct. A given length of duct is placed in a transverse magnetic field and arrangements are made to vary the field strength at a given intermediate point along that distance, such that current parallel to the flow of the liquid is zero at that point. When the desired field pattern has been obtained, the voltage is measured across terminals on either side of the duct at the measuring position. The voltage  $V_t$  thus measured is proportional to the mean velocity of the flow  $V_m$  according to the formula.  $V_t = kV_m$  where  $k$  is a factor which depends on the internal dimensions and wall thickness of the duct, the resistivity of the liquid and on the magnetic field strength at the measuring position. This refinement eliminates the need for calibrating flow meters of this kind of design at several known rates of flow within the range the instrument is built for and, also, for calibrating the apparatus individually for the different liquids to measured.

#### 14497

ELECTROMAGNETIC PUMPS. L. R. Blake and British Thomson-Houston Co., Ltd. British Patent 802,043. Nuclear Eng. **4**, 238(1959) May.

A number of conductors are arranged transversely to the duct carrying an electrically conductive liquid such as a liquid metal, in slots of the pole faces, and are interconnected individually or in groups as a magnetizing winding. This winding is energized by at least part of a current which is passed through the liquid. The conductors are so distributed in the slots that they produce the required gradient in the magnetic field.

## METALLURGY AND CERAMICS

#### 14498 AD-143418

Sintercast Corp. of America, Yonkers, N. Y. RESEARCH ON HEAT RESISTANT ALLOYS STRENGTHENED AT ELEVATED TEMPERATURES BY THE INCORPORATION OF FINE PARTICULATE SUBSTANCES. Interim Report No. 4 [for] May 1 through June 30, 1957. Eric Gregory. 16p. Contract NOas 57-400-C.

Stress rupture, impact, density, and hardness data are given for composite materials based on Stellite 31. The materials containing additions of 22% by volume of

titanium carbide show stress rupture properties higher than those of materials made from powder containing no additions. The effects of adding alumina and boron additions to Stellite 25 were also investigated, but no improvements in rupture life were determined. (auth)

#### 14499 AECU-4142

Gladding, McBean and Co., Inc., Los Angeles.

BIBLIOGRAPHY ON URANIUM DIOXIDE. (284 References). Henry H. Hausner, comp. Mar. 1959. 28p. Contract [AT(04-3)-249]. \$4.80(ph), \$2.70(mf) OTS.

A bibliography of 284 references to AEC reports, U. S. patents, and the periodical literature of the world is presented. (T.R.H.)

#### 14500 AECU-4165

General Electric Co. Missile and Space Vehicle Dept., Philadelphia.

HIGH ENERGY STORAGE CERAMIC CAPACITOR.

Quarterly Report No. 7 [for] July 1, 1958–September 30, 1958. D. A. Lupfer. 58p. Contract AT(30-1)-1963. \$9.30(ph), \$3.60(mf) OTS.

Research and development were directed toward medium (5 in. diameter) disk capacitors and large kiln firing procedures. Disk edge cracking and warping were eliminated. High density, consistently sound disks were produced. One apparently sound 10 in. disk was fired without cracking or warping. Detailed birefringence was found in (Fa, Sr)TiO<sub>3</sub>; further interpretation is in order. Hyperpure materials were made in small lots, and scaling up is underway. Thermal expansion coefficients were determined, and characteristics of materials were measured as a function of temperature. A change in the multiplier relating the uniform field capacitance to the measured capacitance as function of the field was found. A discrepancy between the theoretical capacitance and the measured capacitance for a contoured specimen was discovered. Data are included on the effects of atmosphere during firing, density measurements, effects of additions, particle size distribution, and electrical capacitance. (J.R.D.)

#### 14501 AECU-4166

General Electric Co. Missile and Space Vehicle Dept., Philadelphia.

HIGH ENERGY STORAGE CAPACITOR. Quarterly Report No. 8 [for] October 1, 1958–December 31, 1958. D. A. Lupfer. 65p. Contract AT(30-1)-1963. \$10.80(ph), \$3.90(mf) OTS.

Work continued on the development of ceramic materials with high dielectric constant and high dielectric strength. The fabrication of more and better disks is reported, and studies of the causes for lower density are described. Fully finished capacitors were fabricated. (For preceding period see AECU-4615.) (T.R.H.)

#### 14502 ANL-5958

Argonne National Lab., Lemont, Ill.

CONSTITUTION OF LOW CARBON U-C ALLOYS.

Work completed; December 31, 1957. Bernhard Blumenthal. Feb. 2, 1959. 36p. Contract W-31-109-eng-38. \$1.00(OTS).

The uranium-carbon phase diagram at low carbon concentration was determined by saturation experiments, thermal analysis, and metallography. The system has an eutectic point of 0.98 at. % carbon at 1116.6°C and two eutectoid reactions:  $U_\gamma \rightleftharpoons U_\beta + UC$  and  $U_\beta \rightleftharpoons U_\alpha + UC$ , at 771.8°C and 665.9°C, respectively, 3.0 and 1.8°C below the transformation temperatures of the pure metal. The gamma solubility decreases from

0.30 ± 0.075 at. % at the eutectic temperature to 0.09 ± 0.04 at. % at the eutectoid temperature. The solubility of carbon in beta uranium is probably less than 10 ppm by weight, in alpha uranium less than 3 ppm. A new phenomenon, decarburization of uranium, was discovered. It is caused by the formation on the metal surface, of a face-centered cubic phase, U(C,N), with a lattice parameter  $a_0 = 4.93 \text{ \AA}$  and by diffusion of carbon to the surface. (auth)

#### 14503 ARF-2120-3

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

NIOBIUM PHASE DIAGRAMS. Manuscript Report on Niobium-Oxygen System. Rodney P. Elliott. Apr. 27, 1959. 31p. Contract AT(11-1)-515. \$4.80(ph), \$2.70(mf) OTS.

The Nb-O equilibrium system was determined by metallographic examination of arc-cast alloys made of electron-gun-refined Nb metal and special purity Nb<sub>2</sub>O<sub>5</sub>. Two intermediate oxides. NbO and NbO<sub>2</sub>, melt without decomposition at 1945°C and 1915°C, respectively. Eutectic reactions exist between Nb and NbO at 1915°C and between NbO and NbO<sub>2</sub> at 1810°C. Experimental evidence supports a peritectic reaction between NbO<sub>2</sub> and Nb<sub>2</sub>O<sub>5</sub> at 1510°C. The maximum solid solubility of O in Nb metal is 0.72 wt. %. (auth)

#### 14504 CRL-56

Atomic Energy of Canada Ltd., Chalk River, Ont.

ECONOMIC FUELLING WITH URANIUM DIOXIDE.

O. J. C. Runnalls. 12p. (AECL-808). \$0.50(AECL).

Presented at the Atomic Energy in Industry Conference, Cleveland, April 9, 1959.

Much information pertinent to the development of a more economic fuel cycle has been obtained within the past few years as a result of extensive studies on properties, fabrication methods, and irradiation behavior of uranium dioxide. Recent fabrication and irradiation studies show that Zircaloy-clad assemblies of high density stoichiometric pellets are economic to fabricate, are stable under irradiation at temperatures approaching the melting point even when the core is exposed to water coolant, and exhibit little decrease in thermal conductivity after long irradiations. Such studies have contributed to our present belief that, in large power reactors moderated and cooled with heavy water, a fueling cost of 1.0 mill/kwh should be readily attainable. (auth)

#### 14505 DMIC-112

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.

PHYSICAL AND MECHANICAL PROPERTIES OF NINE COMMERCIAL PRECIPITATION-HARDENABLE STAINLESS STEELS. D. A. Roberts, D. B. Roach, and A. M. Hall. May 1, 1959. 82p. Contract AF18(600)-1375. (AD-214194; PB-151068).

The physical and mechanical properties of commercial precipitation-hardenable stainless steels are presented. The steels covered include the martensitic types (Stainless W and 17-4 PH), the semiaustenitic types (17-7 PH, PH 15-7 Mo, AM 350, and AM 355), and the austenitic types (A-286, 17-10 P, and HNM). Room- and elevated-temperature tensile and compressive properties, stress-rupture and creep properties, and impact, shear, bearing, and fatigue properties are reported. The effects of variations in heat treatment on these properties are also presented. (auth)



**14506 DMIC-Memo-16**

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.  
GLASS-BONDED REFRACTORY COATINGS FOR IRON-OR NICKEL-BASE ALLOYS. T. E. Cook and B. W. King. Apr. 25, 1959. 18p.

Recommended ceramic coatings for iron- and nickel-base alloys, coating compositions, and details of procedures for metal preparations and applications are given. 40 references. (J.R.D.)

**14507 DMIC-Memo-17**

Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio.  
FUTURE APPLICATION TRENDS FOR TITANIUM AND STEEL IN MILITARY AIRCRAFT. W. Stuart Lyman and Fred L. Bagby. May 8, 1959. 6p.

An investigation of future trends in uses of steel and titanium in military aircraft was conducted. Total tonnage was not considered but rather the usage expected in each individual airframe and engine unit likely to be in production during the 1961-1968 period. A summary of the general results and conclusions of the study is presented. (J.R.D.)

**14508 EES-090014A**

Naval Engineering Experiment Station, Annapolis.  
BASIC INFORMATION ON THE BEARING PROPERTIES OF VARIOUS MATERIALS IN LIQUID METALS. W. J. Greenert and M. R. Gross. Feb. 19, 1954. 28p. (AD-146169).

Evaluation of materials for use in antifriction bearings exposed to liquid sodium-potassium alloy is presented. In order to establish certain basic information, however, many of the tests described were performed in lubricating oil. Data are presented on the load carrying capacity of SAE 52100 and 18-4-1 high speed tool steel in oil at 500°F. Superiority for the high speed tool steel was found. Also, the plastic behavior of rollers subjected to high stresses is discussed, and dispersion in the results of the contact roller test is statistically analyzed. The effect of liquid metal on laminated phenolic and glass laminated melamine plastics is presented. It is concluded that the maximum operating temperatures for these materials is 275°F. Results are also presented on the effect of liquid metal on the fatigue strength of SAE 52100 steel. The conclusion is that liquid sodium-potassium is not detrimental to the fatigue properties of this steel. (auth)

**14509 ERI-2447-25-P**

Michigan. Univ., Ann Arbor. Engineering Research Inst.  
ELECTRON METALLOGRAPHIC INVESTIGATIONS OF HEAT-RESISTANT ALLOYS. Progress Report No. 4 [for] August 15 to October 15, 1957. W. C. Bigelow, J. A. Amy, M. W. Devers, J. E. Beissel, and J. A. MacLachlan. Dec. 1957. 16p. Project 7021. Contract AF33(616)-3250. (AD-151919).

The work described includes: (1) the development of techniques for isolating grain-boundary carbides from nickel-base alloys, using extraction replica techniques applied to fractured surfaces, to facilitate studies of the carbides by electron microscopy and identification of them by electron diffraction; (2) preliminary testing of a vacuum cathodic etching apparatus; (3) continued work to identify the minor phases of Udimet-500 alloy and to determine the role of the elements boron and zirconium on the structure and distribution of these phases in the alloy; and (4) the melting, rolling, and heat-treatment

of a series of alloys of special composition preparatory to undertaking studies of the influence of cobalt and molybdenum on the structure and properties of the Udimet-500 alloy. (auth)

**14510 HW-59701**

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

A LABORATORY APPARATUS FOR PRODUCING SWELLING IN URANIUM. J. Martin Tobin and J. H. Sako. Mar. 19, 1959. 17p. Contract W-31-109-Eng-52. \$0.75(OTS).

An apparatus is described which is capable of swelling uranium metal in an ex-reactor experiment. Uranium sheet metal is formed into a hollow cylindrical cathode. An electrical glow discharge in a xenon gas atmosphere at an elevated temperature causes the formation of voids in the uranium. These were observed on several occasions, but cannot be seen in metal treated in an identical manner except for the discharge. Determination of the density of a sample which was exposed for 48 hours in the discharge tube showed a 3.3 per cent increase in the volume of the uranium. Control samples showed no volume increase or bubble formation. (auth)

**14511 KAPL-M-AME-17**

Knolls Atomic Power Lab., Schenectady, N. Y.  
WELDING OF THE S1C CORE SOURCES. E. F. Bulson, A. J. Ciancetta, R. A. Epping, D. R. Hauprich, G. W. Smith, and T. B. Smith. Apr. 23, 1959. 14p. \$3.30(ph), \$2.40(mf) OTS.

Two prime 0.6 curie Ra-Be S1C core sources were successfully fabricated by welding techniques without the use of a hot lab cell. Handling techniques assured that no person received radiation exposure exceeding that permitted for the time period involved. Welds were made using both machine inert arc welding without the addition of filler metal and hand inert arc welding with the addition of filler metal. Results showed that welding of prime parts, which included the RaBe source, did not necessarily produce the same weldments as were obtained on evaluation samples. The evaluation samples were of the same configuration as the prime parts but did not include the RaBe source. (auth)

**14512 KAPL-M-DCB-3**

Knolls Atomic Power Lab., Schenectady, N. Y.  
THE BEHAVIOUR OF ALUMINUM GALVANICALLY COUPLED TO FERROUS ALLOYS IN WATER AT 200°F. D. C. Belouin. Mar. 1959. 16p. Contract W-31-109-Eng-52. \$3.30(ph), \$2.40(mf) OTS.

The corrosion characteristics of carbon steel, stainless steel, and aluminum galvanic couples were examined after eight weeks immersion in deoxygenated, deionized water and in tap water, both at 200°F. These tests were run in an attempt to obtain information pertinent to the SAR fuel element transfer cask design. (auth)

**14513 KAPL-M-RVG-1**

Knolls Atomic Power Lab., Schenectady, N. Y.  
THE EFFECTS OF WATER LOGGING OF B<sub>4</sub>C-ZIRCALOY-2 CLAD POISON STRIP. R. V. Gray. Apr. 1, 1959. 14p. Contract [W-31-109-Eng-52]. \$3.30(ph), \$2.40(mf) OTS.

A scoping experiment to determine the nature of damage to Zircaloy-clad B<sub>4</sub>C poison strips in reactor temperature transients was conducted. Damage is caused by steam generation in defected porous dispersions. Specimens containing 4 to 12 wt. % B<sub>4</sub>C with established leak rates were autoclaved in steam. The

results indicate that clad bulging is restricted to extremely porous dispersions. It is pointed out that stringering of  $B_4C$  during fabrication should be avoided since stringers are the cause of high leak rates. (J.R.D.)

#### 14514 LAMS-2283

Los Alamos Scientific Lab., N. Mex.  
BIBLIOGRAPHY ON THE EFFECTS OF HYDROGEN EMBRITTLEMENT OF METALS: 1952 TO PRESENT. Patricia E. Bell, comp. Dec. 10, 1958. 19p. Contract W-7405-eng-36. \$0.75(OTS).

A bibliography concerned chiefly with the effects of hydrogen on steel and titanium is presented. Literature searched included ASM Review of Literature, Volumes 9 through 14, Battelle Technical Review, Volumes 4 and 5, Chemical Abstracts, Volumes 47 through 50, Nuclear Science Abstracts, Volumes 8 through 11 and part of Volume 12, and LASL card catalogs. 108 references. (J.R.D.)

#### 14515 LMSD-48470

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

BERYLLIUM CRACK PROPAGATION AND EFFECTS OF SURFACE CONDITION. Quarterly Progress Report No. 2. M. Jacobson, W. Jahsman, and C. Matthews. Jan. 31, 1959. 47p. Contract AF33(616)-5978.

Beryllium sheets were received, and test specimen fabrication was begun. Some preliminary tests of the effects of surface finishes are described. A theoretical analysis of the effect of residual stresses on the Griffith crack theory is offered. (T.R.H.)

#### 14516 LR-13627

Lockheed Aircraft Corp., Burbank, Calif.  
HIGH ENERGY RATE METAL FORMING. Interim Engineering Report No. 4 [for] January 1 to March 31, 1959. Glen N. Rardin, A. F. Watts, and G. L. Tingley. 70p. Contract AF33(600)-35543.

The tests performed as part of the effort to select the optimum method for high energy rate metal forming and to establish, by metallurgical examination, the quality of the product of this method are presented. An evaluation of several methods for application of explosive energy to the forming of sheet metal is presented, as well as metallurgical data on the effect of direct application of explosives to the metal. An analysis of elongation and thinning characteristics of typical formed parts is included. (auth)

#### 14517 NASA-M-2-13-59E

National Aeronautics and Space Administration.  
Lewis Research Center, Cleveland.

EXPERIMENTAL EVALUATION OF CERMET TURBINE STATOR BLADES FOR USE AT ELEVATED GAS TEMPERATURES. Patrick T. Chiarito and James R. Johnston. Feb. 1959. 25p.

Cermet blades were successfully subjected to 100-hour endurance tests at normal gas temperatures in a turbojet engine in order to evaluate two methods for mounting them. The method of support considered best for high-temperature operation was then used to mount a group of four cermet blades. This group was subjected to an average turbine-inlet gas temperature of 2000°F. Thermal distortion of the spacer band of the nozzle diaphragm might have caused the premature fracture of one cermet blade after 52 hours. Improved design of a service engine should preclude such failures. (auth)

#### 14518 NASA-M-3-5-59E

National Aeronautics and Space Administration. Lewis Research Center, Cleveland.

STABILITY OF CERAMICS IN HYDROGEN BETWEEN 4000° AND 4500°F. Charles E. May, Donald Koneval, and George C. Fryburg. Mar. 1959. 13p.

The extent of reaction of hydrogen with various carbides, nitrides, borides, and oxides was studied in a static system. Most of these materials,  $HfC$ ,  $ZrC$ ,  $TiC$ ,  $TaC$ ,  $NbC$ ,  $WC$ ,  $Mo_2C$ ,  $HfN$ ,  $ZrN$ ,  $NbN$ ,  $ZrB_2$ ,  $NbB_2$ , and  $WB$ , showed less reaction than the minimum detectable value. However, the data seem to indicate that the ceramics,  $TiN$ ,  $TaN$ ,  $HfB_2$ ,  $TiB_2$ ,  $ZrO_2$ , and  $Cr_2O_3$ , had reacted. Reactions of  $SiC$ ,  $VC$ , and  $TaB_2$  were not determinable because of their incompatibility with the tungsten container. (auth)

#### 14519 NLCO-771

North Carolina State Coll., Raleigh and National Lead Co. of Ohio, Cincinnati.

THERMAL CONDITIONS IN THE BOMB REDUCTION OF  $UF_4$  TO METAL. Kenneth O. Beatty, Jr., and Orville R. Magoteaux. Nov. 28, 1958. 30p. Contract AT(30-1)-1156. \$1.25(OTS).

The thermal and thermodynamic conditions in the bomb reduction of green salt ( $UF_4$ ) by magnesium are discussed. Preheating of the green salt-magnesium charge is stated to be necessary to bring some portion of the charge to ignition temperature (about 900°F) and all of the charge to an average temperature (about 400°F) high enough to assure molten products. The temperature distribution in the charge as a result of preheating has been predicted as a function of the thermal properties and dimensions of the charge and of the preheat time. Adiabatic reaction temperatures of the products have been predicted as a function of average charge preheat temperature and amount and form of excess magnesium in the products. It is pointed out that after ignition, rapid propagation of the reaction is essential if a fluid product is to be formed. Free energy calculations show that for even the highest possible reaction temperatures, thermodynamic equilibrium requires substantially complete reduction of the uranium tetrafluoride to metal before thermodynamic equilibrium is reached. The oxides of uranium, however, may be only partially reduced at the higher temperatures. It is shown that cooling of the magnesium fluoride product to its freezing point can result from chilling effects of the liner and pot alone without loss to the surroundings. The rate of such cooling is shown to depend upon the thermal properties of the liner as measured by the term,  $\sqrt{k\rho c}$ . Liners of low density appear to be a desirable way of reducing the rate of cooling of the reaction products. (auth)

#### 14520 NP-7519

Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.

SOLID SOLUTIONS AND SECOND PHASE STRENGTHENING OF NICKEL ALLOYS AT HIGH AND LOW TEMPERATURES. Regis M. N. Pelloux and Nicholas J. Grant. 20p. Contract NOnr-1841(28).

Five or six alloys each in the systems  $Ni-Cr$ ,  $Ni-Mo$ , and  $Ni-W$ , spaced to cover the single phase areas as well as a part of the adjacent two-phase field, were prepared as vacuum-melted alloys. Tensile tests at room temperature and stress rupture tests at 1200° and 1500°F were run for time periods to give fracture in 0.1 to 500 hours. Observations were made of solid solution and second phase strengthening or weakening, coupled with



studies of ductility and the role of structure on the noted behavior patterns. (auth)

**14521** NP-7528

Battelle Memorial Inst., Columbus, Ohio.

INVESTIGATION OF SINTERABLE POWDERS AND BERYLLIUM OXIDE PROPERTIES. Quarterly Report No. 1 [for] February 15, 1959 through April 30, 1959. A. K. Smalley, J. F. Quirk, and W. H. Duckworth. May 15, 1959. 11p. Contract AF33(616)-6238.

Emphasis during the first quarter was on exploratory experiments with MgO and BeO and on planning a laboratory program. A tentative research program for the 12-month period was developed. Briefly, the program consists of a laboratory study of the effects of processing variables and the character of the starting oxide powder on internal body structures, and correlation of these body-structure characteristics with strength and other properties of the ceramics. Initially, fabrication experiments were made on MgO ceramics, pending receipt of a supply of high-purity BeO powder. The effects of forming pressure and sintering temperature on densification, strength, and crystal size of ceramics made from a selected MgO powder are discussed. Bulk density, room-temperature modulus of rupture, and crystal size of sintered MgO bars varied little between compacting pressures of 50,000 and 100,000 psi. Crystal size increased with sintering temperature in specimens sintered at 2800, 2950, and 3100°F. Room-temperature modulus of rupture appeared to be only slightly affected by changes in sintering temperature. This small variation in moduli-of-rupture values showed the expected inverse relationship with crystal size. A sample of UOX-grade BeO contained less than 450 ppm of cation impurities. Sintering trials indicated that specimens having bulk densities up to 98.5% of theoretical could be prepared by suitable physical processing of the powder with subsequent sintering for 4 hrs at 3000°F in hydrogen. (auth)

**14522** NP-7600

Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

INVESTIGATION OF HIGH TEMPERATURE RESISTANT MATERIALS. Quarterly Report No. 14 [for] February 1, 1959 to April 30, 1959. C. R. Mason, J. D. Walton, M. D. Bowen, and W. T. Teague. 28p. Project No. A-212. Contract NOrd-15701.

Thermal Protection Systems. Coatings of W, ZrO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, and Al were applied to slip-cast fused silica for evaluation in the exhaust of the oxyhydrogen motor. The thermal conductivity of slip-cast fused silica was found to vary linearly with temperature over a range from 420 to 1350°F with values of 0.36 and 0.42 (Btu)-(ft)/(hr) (sq ft) (°F), respectively. Data were obtained by exposing one-half-inch-thick slip-cast fused silica slabs at various angles to the exhaust of the oxyhydrogen motor. Coatings. A variety of powdered refractory materials was obtained for use in the arc spray gun. During preliminary operation, coatings were obtained from ZrO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, W, WC, CaZrO<sub>3</sub>, B<sub>4</sub>C, HfO<sub>2</sub>, and MgO. A technique for forming thin shapes by flame spraying onto a removable brass pattern was developed. Thermets. Certain physical properties of Be-chromic oxide thermets were determined using either BeO or Cr as the reaction throttler. (W.L.H.)

**14523** NP-7601

Massachusetts Inst. of Tech., Cambridge. Corrosion Lab.

NEW PERSPECTIVES IN THE STRESS CORROSION PROBLEM. Herbert H. Uhlig. [1958]. 25p.

Stress corrosion cracking in metals and alloys is discussed. In alloys impurities may enter the mechanism. Hydrogen cracking of steels and cracking of Mg<sub>2</sub>Sn crystals without stress in distilled water are pointed out as resembling stress corrosion cracking, but no corrosion occurs in these mechanisms. The electrochemical mechanism is not sufficient to explain this, so it is proposed that selective adsorption of ions lowers the surface energy cooperating with electrochemical action. (T.R.H.)

**14524** NP-7602

Massachusetts Inst. of Tech., Cambridge. Corrosion Lab.

SOME METALLURGICAL FACTORS AFFECTING STRESS CORROSION CRACKING OF AUSTENITIC STAINLESS STEELS. H. H. Uhlig and R. A. White. [1958]. 28p.

Tests of 18-8 stainless steels in boiling 42% MgCl<sub>2</sub> show that alloys with 0.015% C or 0.01% N or less do not fail at 200 to 260 hours. Commercial 304 alloys fail in 0.2 to 1.4 hr. Stable austenitic steels (20% Cr, 20% Ni) are similarly resistant if N<sub>2</sub> content is below 0.002%. Carbon confers resistance to cracking in 304 stainless steels. The action of Ti, Nb, Si, Co, and B is also discussed. A mechanism is offered. (T.R.H.)

**14525** ORNL-2687

Oak Ridge National Lab., Tenn.

IMPROVEMENT OF THE HIGH-TEMPERATURE STRENGTH PROPERTIES OF REACTOR MATERIALS AFTER FABRICATION. R. W. Swindeman and D. A. Douglas. June 15, 1959. 24p. Contract W-7405-eng-26. \$4.80 (ph), \$2.70 (mf) OTS.

Possibilities are reviewed for improving the high-temperature strength properties of three nickel-base alloys after fabrication of sheet material. Creep and tensile data are presented for Inconel, Hastelloy B, and INOR-8. Depending on the material and service conditions, improvements in strength can be brought about by treatments such as annealing or aging, carburization, and environmental control during service. Data showing the relative strengthening by each of these means are presented. Carburization produces the greatest increase in creep strength. Although the improvements are not as pronounced as in the case of carburization, nitriding and oxidizing environments also can increase the creep life over the life in argon. Optimum annealing or aging treatments, however, are dependent on the anticipated service temperature and stress. (auth)

**14526** WADC-TR-54-616(Pt. 5)

Battelle Memorial Inst., Columbus, Ohio.

HYDROGEN CONTAMINATION IN TITANIUM AND TITANIUM ALLOYS. PART V. HYDROGEN EMBRITTLEMENT. [Period covered] March 1957 to March 1958. D. N. Williams, F. R. Schwartzberg, and R. I. Jaffee. Nov. 24, 1958. 99p. Project title: METALLIC MATERIALS. Task title: TITANIUM AND TITANIUM ALLOYS. Contract AF33(616)-5007. (AD-209378).

Extensive investigations intended to provide information relating to the mechanism of H embrittlement in titanium-base alloys were carried out. Studies included detailed measurements of the effects of temperature, strain rate, and H content on embrittlement, examination of all-alpha and all-beta alloys for susceptibility to embrittlement, calculations of probable H solubility in alpha and beta Ti, and several other informative investigations. An embrittlement mechanism is outlined. Alloys previously prepared and examined to

determine the effects of alloy content and microstructure on H embrittlement were further studied by means of notched stress-rupture tests. This work resulted in alteration of previously expressed conclusions regarding alloying and microstructural effects. (auth)

**14527** WADC-TR-55-87(Pt. 6)

Franklin Inst. Labs. for Research and Development, Philadelphia.

TREATMENT OF METAL SURFACES FOR ADHESIVE BONDING. PART VI. SUMMARY OF METHODS. Period covered: February 1, 1954 to June 30, 1957. Richard Lindsay, Jr. Nov. 15, 1957. 15p. Project title: RUBBER, PLASTIC, AND COMPOSITE MATERIALS. Task title: STRUCTURAL ADHESIVES. Contract AF33(616)-2347. (AD-150999).

Methods for surface preparation of stainless steel, Ti, Al, and Mg for adhesive bonding are presented. The treatments are those that were found to be most promising when used with certain adhesives. (auth)

**14528** WADC-TR-57-298(Pt. 13)

Ford Motor Co., Dearborn, Mich.

IRON-ALUMINUM ALLOY SYSTEMS. PART 13. DEVELOPMENT OF CREEP RESISTING COMPOSITIONS. [Period covered]: October 1958 through March 1959. Roger H. Richman. Apr. 1959. 22p. Project No. 7351. Contract AF33(600)-32448. (AD-213472).

Utilization of oxidation-resistant Fe-7% Al as a basis for creep-resisting high-temperature materials was the objective of the research described. Data are presented to illustrate the effects of 1 to 4% Mo and  $\frac{1}{2}$  to 1% Ti upon the mechanical and metallurgical properties of Fe-7% Al. All the compositions except those containing a nominal 0.25% Si demonstrated good room temperature mechanical properties, after oil-quenching or air cooling from the recrystallization anneal, but only alloys of 3 and 4% Mo and  $\frac{1}{2}$  to 1% Ti possessed promising elevated temperature properties. From correlation of age-hardening studies with stress-rupture test results it was concluded that Mo and Ti served primarily as solid solution strengtheners. Suggestions for the modification of the composition to improve the high temperature performance are presented. (auth)

**14529** WADC-TR-57-744

General Electric Co. Instrument Dept., West Lynn, Mass.

A JET ENGINE THERMOCOUPLE SYSTEM FOR MEASURING TEMPERATURES UP TO 2300°F. Michael E. Ihnat. Oct. 1958. 125p. Project No. 3073-30245. Contract AF33(600)-32302. (AD-203393).

A reliable thermocouple temperature sensing system for aircraft jet engines having an operating temperature range of 1800°F (982°C) to 2300°F (1260°C) has been developed. The purpose of this system is for pre-turbine installation to allow potential increases in engine thrust. The system is unique in that it uses a thermoelement combination of palladium and platinum 15% iridium. Provisions are also made for matching lead wires up to ambient temperatures in the 1300 to 1500°F (704° to 816°C) temperature range. The system has been shown to be reliable over the specified temperature range for a 400 hour period. (auth)

**14530** CEA-tr-R-631

RÉSISTANCE D'ENDURANCE AUX HAUTES TEMPERATURES DES JOINTS SOUDES. (Prolonged High Temperature Resistance of Welded Joints.) A. V. Stanyukovitch (Stanioukovitch) and V. C. Zemzin

(Zemzine). Translated into French by B. Vinogradoff from *Metalloved, i Obrabotka Metal.* 2, 12-18(1958). 17p.

The resistance of welded joints under static stresses and temperatures to 600°C was studied on perlite and austenitic steel samples. When the stress is applied perpendicular to the weld joint, the resistance is determined by the resistance of the weakest zone. If the stress is applied along the axis of the joint, the plastic properties of the entire assemblage determine the resistance. Weld joints between perlite and austenitic steel have greater resistance than perlite steel welds for stresses along the joint axis. (J.S.R.)

**14531** HW-tr-3

THE STRUCTURAL THEORY OF METAL CREEP. (La Theorie Structurale du Fluage des Metaux.) A. Oding. Translated by Liz Appleby (Hanford Atomic Products Operation) from *Rev. met.* 55, 448-52(1958). 16p. \$3.30(ph), \$2.40(mf) JCL.

Experimental data indicate that metal deformations under stress at high temperature are processes related to the formation, motion, and the interaction of dislocations and other imperfections of the crystal lattice. These factors predetermine the creep rate as well as the processes where diffusion occurs, including the interaction due to contact of the different phases which are present. Theory of metal creep is developed, and it is concluded that the creep rate is proportional to the number of dislocations liable to be moved. The equations for distribution curves as a function of the values for critical stresses, as well as dislocation sources and damped dislocations, were established. (J.R.D.)

**14532**

MOLYBDENUM IN ALLOY STEEL CASTINGS.

G. French and B. H. C. Waters. *Alloy Metals Rev.* 9, No. 91, 2-11(1959) Mar.

Alloy steels, giving superior mechanical properties, can be reliably obtained on a foundry basis. Molybdenum is one of the elements which contributes; small additions increase the hardenability, reduce temper brittleness and give usefully high creep resistance at moderately high temperatures. Some of the properties of steel castings containing this element are discussed and reference made to typical applications. (auth)

**14533**

TWO NEW ALLOYS OVERCOME Cb BAD POINTS.

R. B. Norden, ed. *Chem. Eng.* 66, 208(1959) June 15.

The physical and high-temperature properties of a Nb-Zr and a Nb-Ta-Zr alloy are tabulated and discussed. The Ta-containing alloy offers oxidation resistance superior to pure Nb; however, the density is greater (8.57 compared to 10.26). (T.R.H.)

**14534**

NEW STAINLESS STEELS RESIST PITTING, ABRASION.

R. B. Norden, ed. *Chem. Eng.* 66, 210, 212(1959) June 15.

The properties of PH-55A, PH-55B, and PH-55C stainless steels are tabulated and compared with other stainless steels. These metals offer high strength without severe cold working, and they are corrosion and abrasion resistant. (T.R.H.)

**14535**

TRANSFORMATIONS PRODUCED BY THE IONIC BOMBARDMENT OF A PYRITE SURFACE. Jean-Jacques Trillat and Kazuhiro Milhama. *Compt. rend.* 248, 2827-32(1959) May 20. (In French)



The effect of an oxygen ion beam on a natural face of a pyrite monocrystal was studied by the simultaneous use of electron microscopy and diffraction. It is shown by the very rapid appearance of an oriented layer of the  $\text{Fe}_3\text{O}_4$  oxide, whose thickness increases with the length of ion bombardment. The formation of the oxide starts along the surface faults of the crystal. (tr-auth)

**14536**

VARIATION OF THE TRANSITION TEMPERATURES OF SUPERCONDUCTING ALLOYS OF LANTHANUM AND OF OTHER RARE EARTHS WITH THE SOLUTE SPIN. Alexei Maradudin and Jean Peretti. *Compt. rend.* **248**, 2856-8(1959) May 20. (In French)

It has been shown that the transition temperature of superconducting lanthanum is lowered when a given fraction of lanthanum is replaced by another rare earth, a quantity dependent on the spin of the dissolved atom (Matthias et al. *Phys. Rev. Letters* **1**, 449(1958)). This effect can be explained if the exchange interaction between the conduction electrons and the 4f electrons is considered. The equation for the transition temperature is derived on this basis. (J.S.R.)

**14537**

DIRECT OBSERVATION, WITH THE AID OF AN ELECTRON MICROSCOPE, OF THE MUTUAL CANCELLATION OF DISLOCATIONS DURING RESTORATION ANNEALING OF A COLD-WORKED Al-Mn ALLOY. Adrien Saulnier and Paul Mirand. *Compt. rend.* **248**, 2871-2(1959) May 20. (In French)

Direct electron microscopy reveals individual dislocations of the sub-grain sides of a cold-worked alloy. The pattern of these dislocations between opposed sides can be photographed during the anneal. The progressive disappearance of a side by cancellation of its dislocations and the increase of the average free path which results were observed. (tr-auth)

**14538**

MECHANISM OF INTERCRYSTALLINE CORROSION OF STAINLESS STEEL IN NITRIC ACID. A. I. Krasil'shchikov, L. M. Volchkova, I. K. Burtseva, and V. D. Plyasunov. *Doklady Akad. Nauk S.S.S.R.* **125**, 1285-7(1959) Apr. 21. (In Russian)

It is shown that a current appears between two stainless steel electrodes submerged into nitric acid solutions of various concentrations; the electrode in the stronger concentration acts as cathode and the electrode in the weaker solution acts as anode. Effects of various concentrations of  $\text{HNO}_3$  and various admixtures of  $\text{Cr}^{3+}$ ,  $\text{Cr}^{6+}$ , and  $\text{Fe}^{3+}$  on the behavior of stainless steel at 60°C are shown graphically. (R.V.J.)

**14539**

SOME FEATURES OF THE CATHODE PROCESS ON STAINLESS STEEL IN NITRIC ACID SOLUTIONS. E. N. Mirolubov, M. M. Kurtepov, and N. D. Tomashov (Inst. of Physical Chemistry, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* **125**, 1288-91 (1959) Apr. 21. (In Russian)

The cathode polarization curves were plotted for stainless steel (chromium steel with 17 to 28% Cr annealed at 760°C, and chromium-nickel steel of 18-8 type with niobium annealed at 1050°C) and platinum corrosion in 3% completely dissociated nitric acid and in 30%  $\text{HNO}_3$  containing non-dissociated homopolar molecules. (R.V.J.)

**14540**

EFFECTS OF CHEMICAL COMPOSITION ON THE TEMPERATURE MAGNETIC AGING IN IRON-

COBALT-NICKEL-ALUMINUM ALLOYS. A. M. Morozova and F. I. Feigina. *Fiz. Metal. i Metalloved.* **7**, 40-7(1959) Jan. (In Russian)

The effects of Al, Co, Cu, and Ni content in iron-cobalt-nickel-aluminum alloys and of Nb and Ta in magnesium-nickel alloys on their magnetic stability were studied in order to find means for improving the stability of the alloys. (R.V.J.)

**14541**

REACTIONS OF NATURAL THERMOCOUPLE THERMOELECTROMOTIVE FORCE TO STRUCTURAL CHANGES IN HIGH-SPEED STEEL. M. F. Semko and L. S. Palatnik (Khar'kov Polytechnic Inst., USSR). *Fiz. Metal. i Metalloved.* **7**, 48-52(1959) Jan. (In Russian)

The dependence of the thermoelectromotive force of natural thermocouples on the type of thermal treatment of P18 steel (0.75% C, 0.3% Mo, 1.55% V, and 18.3% W) and the effects of soaking time at 500 and 600°C on the thermoelectromotive force stability in a standard treated P18 steel were studied. (R.V.J.)

**14542**

EFFECTS OF DEUTERON IRRADIATION ON THE ELECTRIC CONDUCTIVITY OF ORDERED  $\text{Ni}_3\text{Fe}$  AND  $\text{Fe}_3\text{Al}$  ALLOYS AND AGING OF Fe-Ni-Ti ALLOY. M. A. Artsishevskii, S. S. Vasil'ev, G. V. Koshelyaev, and Ya. P. Selisskii (Central Research Inst. of Ferrous Metals, USSR). *Fiz. Metal. i Metalloved.* **7**, 53-6(1959) Jan. (In Russian)

The radiation effects of 4-Mev deuterons on the electric resistance of ordered  $\text{Ni}_3\text{Fe}$  and  $\text{Fe}_3\text{Al}$  alloys and aging of 35% Ni-4.5% Ti-60.5% Fe alloy were investigated. The changes in  $\text{Fe}_3\text{Al}$  and  $\text{Ni}_3\text{Fe}$  electric resistance induced by various deuteron beams were tabulated. Irradiation by fluxes up to  $5 \times 10^{16}$  deuterons/cm<sup>2</sup> induced strong changes in the electric conductivity. With a further rise of the integral flux, the changes in electric conductivity were not so pronounced. The preliminary thermal treatments of the specimens played an important part in the electric conductivity of the irradiated materials. (R.V.J.)

**14543**

X RAY INVESTIGATION OF THE HIGH COERCION STRUCTURE OF Al-Cu-Fe-Ni ALLOYS. I. N. Barutkin and B. Ya. Pines (Khar'kov State Univ., USSR). *Fiz. Metal. i Metalloved.* **7**, 57-63(1959) Jan. (In Russian)

A strongly smeared  $\beta$  phase line found near the  $\beta_2$  phase in thermally treated Al-Cu-Fe-Ni alloy (14.5% Al, 4% Cu, 59.9% Fe, and 25% Fe, and 25% Ni) was studied. It is shown that large-magnitude  $H_c$  is caused by high ferromagnetic dispersion in the  $\beta$  phase and by impregnations of particles into the weakly magnetic  $\beta_2$  phase. (tr-auth)

**14544**

DEFORMATION OF CRYSTALLINE STRUCTURE OF NICKEL BASE ALLOYS AT 20 TO 500°. B. M. Rovinskii, A. I. Samoilov, and G. M. Rovenskii (All-Union Research Inst. of Aviation Materials, USSR). *Fiz. Metal. i Metalloved.* **7**, 79-90(1959) Jan. (In Russian)

The lattice deformation in heat resisting nickel alloys was investigated at 20 to 500°C in order to determine the magnitudes of various distortions and their ratio and temperature dependence. (R.V.J.)

**14545**

EFFECTS OF PLASTIC DEFORMATION TEMPERATURE ON THE STRUCTURE AND TOUGHNESS OF AUSTENITE STEEL. K. A. Malyshev, G. N. Bogacheva,

V. D. Sadovskii, and P. A. Ustyugov (Inst. of Metal Physics, Academy of Sciences, USSR). Fiz. Metal. i Metalloved. **7**, 102-9(1959) Jan. (In Russian)

The structure of austenitic steel under compression at 20 to 1200°C was studied in order to determine the relationship between structural changes and mechanical properties in tough and fragile (after aging) states. (R.V.J.)

#### 14546

PLASTIC DEFORMATION OF IRON IN  $\gamma \rightarrow \alpha$  PHASE TRANSITIONS. B. G. Lazarev, A. I. Sudovtsov, and A. P. Smirnov (Inst. of Physics and Tech., Academy of Sciences, Ukraine SSR). Fiz. Metal. i Metalloved. **7**, 122-7(1959) Jan. (In Russian)

Non-reversible alterations in iron during  $\gamma \rightarrow \alpha$  transitions were uncovered by dilatometric measurements. Descriptions are given of the equipment, method, and results of studies made of such residual type deformation (a different type than that caused by thermal tension) occurring in the phase transition. (R.V.J.)

#### 14547

EFFECTS OF HYDROSTATIC COMPRESSION ON THE MECHANICAL PROPERTIES OF ALUMINUM AFTER STRONG PLASTIC DEFORMATION. B. I. Beresnev, L. F. Vereshchagin, and Yu. N. Ryabinin (Lab. of Super High Compressions, Academy of Sciences, USSR). Fiz. Metal. i Metalloved. **7**, 128-32(1959) Jan. (In Russian)

The effects of hydrostatic compression on the mechanical properties of aluminum at various degrees of preliminary extrusion were studied with four-step extrusion specimens which permitted deformation from  $x = 0.704$  to  $x = 0.95$  at 4000 to 7000 kg/cm<sup>2</sup>. (R.V.J.)

#### 14548

DEFORMATION DIAGRAM OF DYNAMIC BEND IN STEEL. V. G. Savitskii, K. V. Popov, and L. A. Gaivoronskii (East-Siberian Branch of the Academy of Sciences, USSR). Fiz. Metal. i Metalloved. **7**, 133-6(1959) Jan. (In Russian)

Comparative studies were made of the static and dynamic bend of various steel specimens. Detailed diagrams were plotted and new data were obtained on the relation between the mechanical characteristics in static and dynamic tests. It is shown that the resilience of steel is determined not by the strength factor of the specimen but by the magnitude of the plastic deformation. (R.V.J.)

#### 14549

SOLUBILITY AND ACTIVITY OF OXYGEN IN METALLIC MELTS. V. V. Averin, A. Yu. Polyakov, and A. M. Samarin. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 1, 13-21(1959) Jan.-Feb. (In Russian)

The solubility and activity of oxygen in liquid iron and liquid Cr-Fe, Co-Ni, Fe-Ni, and Co-Ni alloys were investigated, and the dissociation pressure of Al with the oxidizing element Al<sub>2</sub>O<sub>3</sub>, Cr with Cr<sub>2</sub>O<sub>3</sub>, Mn with MnO, Si with SiO<sub>2</sub>, Ti with TiO<sub>2</sub>, and V with V<sub>2</sub>O<sub>5</sub>, CoO, and NiO was tabulated at 1600°C. (R.V.J.)

#### 14550

SUBSTRUCTURE ALTERATIONS DURING ANNEALING OF COLD DEFORMED ALUMINUM. E. P. Kostyukova and B. M. Rovinskii. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 1, 55-9(1959) Jan.-Feb. (In Russian)

The substructure changes were studied using an x-ray reverse beam passing through a narrow cross-shaped

diaphragm. X-ray pictures showing the interference bands in deformed and in annealed aluminum are included. (R.V.J.)

#### 14551

ON THE MAGNETIC SUSCEPTIBILITY OF LIQUID ALUMINUM-ANTIMONY AND ANTIMONY-GALLIUM ALLOYS. A. A. Vertman and V. M. Glazov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 1, 60-3(1959) Jan.-Feb. (In Russian)

The temperature and concentration dependence of Al-Sb and Ga-Sb magnetic susceptibility was studied in order to determine the interaction properties at various temperatures. The isotherms of magnetic susceptibility of Al-Sb and Ga-Sb in relation to the equilibrium constitution diagram were plotted at 1000 to 1300°C. (R.V.J.)

#### 14552

EFFECTS OF VANADIUM, TUNGSTEN, CHROMIUM AND MOLYBDENUM ON THE INTERNAL FRICTION AND AGING RATE OF TECHNICAL IRON. M. G. Lozinskii and A. E. Fedorovskii (Inst. of Machine Building, Academy of Sciences, U.S.S.R.). Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 1, 64-70(1959) Jan.-Feb. (In Russian)

Measurements were made of the internal friction in technical iron alloyed with various quantities of Cr, Mo, V, and W. All alloys were annealed at 750°C for two hours and tempered at 680°C. The temperature dependence of the internal friction curves are plotted, and microphotographs at various agings are included. (R.V.J.)

#### 14553

APPEARANCE OF SUPERPLASTICITY IN MOLTEN EUTECTOIDS. A. A. Presnyakov and G. V. Starikova. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 1, 75-7(1959) Jan.-Feb.

Experiments were conducted with Al-Cu (33% Cu), Al-Si (11.7% Si), Al-Ni (5.7% Ni), and Al-Fe (1.9% Fe) in order to determine the conditions of eutectic superplasticity. In addition to tests on the elongation of specimens, microstructure and x-ray analyses were made of the fast-cooled recrystallization and hot-deformation microsection (at  $\approx 50\%$  cold hardening and tempering at 250°C for 5 hours). For Al-Si and Al-Cu the highest plasticity points were found at 500°C and near the eutectic temperature, with constriction of 0.90 and elongation of 117%, while in Al-Ni and Al-Fe effects of superplasticity were not observed. The elongation in Al-Ni eutectics is about 60% and in Al-Fe it is about 48%, though the plasticity reaches 1.00 at 500°C. However, the plasticity of these specimens begins to grow at an earlier point ( $\approx 300^\circ$ ) than in Al-Si or Al-Cu. The x-ray and microstructure pictures of specimens after hot deformation and tempering and after annealing from a liquid state are included. (R.V.J.)

#### 14554

THERMAL FRACTURE RESISTANCE OF CERAMIC COATINGS APPLIED TO METAL. I. ELASTIC DEFORMATION. J. H. Lauchner and D. G. Bennett (Univ. of Illinois, Urbana). J. Am. Ceram. Soc. **42**, 146-50(1959) Mar.

A study was made of the resistance to thermal fracture of four ceramic coatings of the cobalt-bearing ground-coat type applied to enameling-grade iron specimens. The study was made of coated-metal systems in the unsteady state, symmetrically cooled, and in the absence of viscous or plastic flow. Determina-



tions were made of the elastic characteristics of the coating-metal composites, the effective coefficient of linear expansion, the temperature at which the coating and base metal were at dimensional equilibrium, and the temperature differential sufficient to induce coating fracture when water quenched. Coating-metal thickness ratios were correlated with the maximum specimen temperature withstood in water quenching without coating fracture. Studies indicated that ceramic coatings, after receiving a given thermal treatment, fracture when subjected to a thermal shock by a critical temperature differential. When no residual coating stress is present, thermal shock resistance is inversely related to the thermal expansion characteristics of the coating. The critical stress at which coating fracture occurs may be expressed as the sum of thermal and residual stresses developed in annealed systems in which viscous or plastic flow does not occur. Residual compressive stress in a coating is a major factor in improved thermal shock resistance. Increased thermal shock resistance is gained by decreased coating thickness. (auth)

**14555****CERAMIC PROPERTIES OF EUROPIUM OXIDE.**

C. E. Curtis and A. G. Tharp (Oak Ridge National Lab., Tenn.). *J. Am. Ceram. Soc.* **42**, 151-6(1959) Mar.

Europium oxide of 99.7% purity was compacted into small bars and pellets which were fired at temperatures from 1050 to 1700°C for 2 to 120 hours in atmospheres that were oxidizing, mildly reducing (open furnace), or strongly reducing. It was found that europium oxide compacts fired in oxygen for 2 hours at 1500°C had attained a density of 90% of theoretical and were stable in boiling water. Compacts fired under mildly reducing conditions at 1500°C for 2 hours had attained a density of 84% of theoretical and disintegrated in boiling water. Those fired similarly in a hydrogen atmosphere began to fuse at 1500°C. The linear thermal expansion of the compacts fired at 1500°C in the open furnace was  $10.5 \times 10^{-6}$  in. per in. per °C between 0 and 1000°C and their molar specific heat between 0 and 800°C was 33.3 cal. Careful investigation of the structural changes occurring in europium oxide with rising temperature revealed that the low-temperature (body-centered cubic) form inverts slowly to the high-temperature form at approximately 1050°C, the high-temperature form has monoclinic symmetry, and it does not revert readily to the cubic form; its theoretical density was calculated to be 8.18 g per cm.<sup>3</sup>. (auth)

**14556****PLUTONIUM METALLURGY IN THE UNITED**

**KINGDOM.** M. B. Waldron (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *J. Metals* **11**, 339-43(1959) May.

Power and economic considerations make the development of plutonium technology in the UK more attractive than development of technology related to U<sup>235</sup>. British progress in plutonium development in the areas of preparation, physical properties, and alloying behavior is reported. In addition, irradiation studies are discussed as well as fabrication studies and ceramic research. (J.R.D.)

**14557**

**GRAPHITE MACHINING.** *Nuclear Eng.* **4**, 206-15(1959) May.

Graphite machining facilities at four British establishments are described. These industries meet the re-

quirements of the gas-cooled graphite moderated reactor program. (J.R.D.)

**14558****NUCLEAR MAGNETIC RESONANCE IN SILVER-**

**CADMIUM.** L. E. Drain (Atomic Energy Research Establishment, Harwell, Berks, Eng.). *Phil. Mag.* (8) **4**, 484-501(1959) Apr.

Nuclear magnetic resonance shifts and line widths have been measured in alloys of silver and cadmium at 300°K in a field of 4200 gauss. The resonances of Ag<sup>109</sup> and Ag<sup>107</sup> nuclei were observed in the  $\alpha$  and  $\beta$  phases and those of Cd<sup>113</sup> and Cd<sup>111</sup> nuclei in all the room temperature phases. In primary solutions of cadmium in silver, the Knight shifts of all the resonances decrease linearly as the cadmium content increases, the total variation being about 14% of their values at the center of the phase range. It is shown that in a disordered alloy a contribution to nuclear magnetic resonance line width can arise from the variations of the shifts of nuclei with their immediate surroundings. The results suggest that in  $\alpha$  silver-cadmium alloys, the influence of the cadmium atoms on the shift of silver nuclei is confined to nearest and next nearest neighbors. Line widths in the  $\beta$  phase suggest an ordered structure. The relation of nuclear magnetic resonance shifts to the density of states at the Fermi surface is discussed and a calculation of the variation of this quantity with composition made from the Knight shift results. The result is compared with other experimental and theoretical evidence. (auth)

**14559**

**THE ELECTRICAL RESISTIVITY AND SUPERCONDUCTIVITY OF SOME URANIUM ALLOYS AND COMPOUNDS.** B. S. Chandrasekhar and J. K. Hulm (Westinghouse Research Labs., Pittsburgh). *Phys. and Chem. Solids* **7**, 259-67(1958) Nov.

The electrical resistivity and superconductivity of a series of  $\alpha$  (orthorhombic) and quenched  $\gamma$  (body-centered cubic) binary alloys of uranium with niobium and molybdenum were investigated at temperatures down to 1°K. Anomalous resistivity behavior occurs in both types of structure. The  $\gamma$  alloys are particularly unusual in possessing a negative temperature coefficient from room temperature down to the superconducting transition point. Both systems exhibit superconducting transitions, the  $\gamma$  alloys in the vicinity of 2°K and the  $\alpha$  alloys closer to 1°K. Some success was achieved in a qualitative interpretation of the resistive and superconductive properties of the alloys in terms of a hypothetical band structure of uranium. Ten intermetallic compounds of uranium were also tested for superconductivity down to about 1°K. Four new superconductors were discovered: UCo (1.70°K), U<sub>6</sub>Mn (2.32°K), U<sub>6</sub>Fe (3.86°K) and U<sub>6</sub>Co (2.29°K). The last three compounds are isomorphous and include the first superconducting compounds of manganese and iron. (auth)

**14560****NEUTRON-IRRADIATION EFFECTS ON COPPER-**

**ALUMINUM ALLOYS.** M. S. Wechsler and R. H. Kernohan (Oak Ridge National Lab., Tenn.). *Phys. and Chem. Solids* **7**, 307-26(1958) Dec.

The effect of neutron irradiation and subsequent thermal treatment on the electrical resistivity of  $\alpha$ -phase Cu-Al alloys has been studied. It is found that a solid-state reaction that causes a decrease in resistivity is triggered or accelerated by irradiation at 32 to 45°C. The effect is absent in pure copper and

increases with aluminum content. The resistivity decrease for the 15 atomic per cent aluminum alloy is about  $0.2 \mu\Omega\text{-cm}$ . When the irradiation is conducted at  $-120^\circ\text{C}$ , no decrease in resistivity is observed, but the decrease in resistivity sets in upon subsequent warming above  $-50^\circ\text{C}$ . Several explanations for these effects are discussed. (auth)

**14561**

MICROSCOPY AT LIQUID HELIUM TEMPERATURES: PHASE TRANSITION IN SODIUM. D. Hull (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and H. M. Rosenberg (Clarendon Lab., Oxford). Phys. Rev. Letters **2**, 205-6(1959) Mar. 1.

The surface of a sodium specimen was examined under high magnification while it was at a temperature near that of liquid helium. For this purpose a small portable cryostat was designed which would fit under the objective of an ordinary standard microscope. The observations show that at  $20^\circ\text{K}$  about 45% of the sodium has undergone martensitic transformation. (W.D.M.)

**14562**

RARE-EARTH HARDMETALS. I. Binder and R. Steinitz (Firth Sterling, Inc., Yonkers, N. Y.). Planseeber. Pulvermet. **7**, 18-21(1959) Apr.

The rare-earth metals such as gadolinium, samarium, and europium have created interest for the application in atomic reactors as control rods because of their high thermal-neutron capture cross section. It is well known that the rare-earth metals form carbides, nitrides, borides, and silicides. Especially the two latter compounds show distinct metallic character. Hot pressed samples of gadolinium hexaboride  $\text{GdB}_6$  were investigated more closely as to structure, physical and scaling properties. Dysprosium disilicide  $\text{DySi}_2$  has been examined in the same direction. The application of these hardmetal compounds is restricted because of their present high price. (auth)

**14563**

ISOTHERMAL MASS TRANSFER IN LIQUID METALS. A. K. Covington and A. A. Woolf (Associated Electrical Industries, Ltd., Aldermaston, Berks, Eng.). Reactor Technol. **1**, 35-41(1959) Apr.

A survey of pairs of metals in liquid bismuth, lead and tin has shown that isothermal mass transfer with the formation of an alloy layer on an insoluble metal occurs in the systems:  $\text{Al} \rightarrow \text{Mo}$ ,  $\text{Al} \rightarrow \text{Fe}$ ,  $\text{Ni} \rightarrow \text{Fe}$ ,  $\text{Co} \rightarrow \text{Fe}$ ,  $\text{Al} \rightarrow \text{Cr}$ ,  $\text{Co} \rightarrow \text{Nb}$ ,  $\text{Co} \rightarrow \text{Ta}$  in liquid bismuth;  $\text{Al} \rightarrow \text{Mo}$ ,  $\text{Zn} \rightarrow \text{Fe}$ ,  $\text{Al} \rightarrow \text{Fe}$ ,  $\text{Ni} \rightarrow \text{Fe}$  in liquid lead; and  $\text{Al} \rightarrow \text{Mo}$  in liquid tin at  $500^\circ\text{C}$ . Although transfer is expected when compounds or solid solutions exist between the pairs, it has only been found with a minority of systems. Factors affecting the phenomenon are discussed. (auth)

**14564**

SOME OBSERVATIONS ON PLUG FORMATION DURING THE CIRCULATION OF METALLIC SLURRIES BY CONVECTION. G. H. Broomfield, N. F. Eaton, G. W. Greenwood, and B. Sharpe (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Reactor Technol. **1**, 42-6(1959) Apr.

Apparatus is described in which slurries of  $\text{UPb}_3$  particles in liquid lead and  $\text{ThBi}_2$  particles in liquid bismuth were prepared and circulated by thermal convection around chrome-iron loops in the temperature range proposed for their potential use in liquid metal fuelled reactors. The loop material was unaffected by the circulating  $\text{UPb}_3$ -liquid lead slurry and by the

$\text{ThBi}_2$ -liquid bismuth slurry when magnesium and zirconium were added to the bismuth as corrosion inhibitors. The loops eventually plugged by the accumulation and growth of slurry particles at the coldest part of the loops but not at the lowest part despite the particles being denser than the liquid. It is considered that slurry particles which have negligible solubility in the liquid should not show this effect. The  $\text{ThBi}_2$ -liquid bismuth slurry without corrosion inhibitors attacked the hot limb of the loop and intergranular penetration of the tube walls enabled solid material to enter the liquid stream in amount considerably greater than that in solution. In this case both the mass transfer of tube wall material and the accumulation and growth of  $\text{ThBi}_2$  particles contributed to form a plug at the coldest part of the loop. The structures of the plugs were examined metallographically. (auth)

**14565**

THE DEVELOPMENT OF POROSITY IN URANIUM DURING THERMAL CYCLING. A. A. Bocharov and G. I. Tomson. Reactor Technol. **1**, 47-9(1959) Apr.

During rapid thermal cycling tests, in which the duration of each cycle was 50 sec, considerable changes occurred in uranium. The extent of the changes depended on the temperature interval of each cycle. Thermal cycling in the  $\alpha$ -range to an upper temperature of  $550$  to  $600^\circ\text{C}$  caused a directional deformation in textured uranium containing about 0.1 per cent carbon. The growth was accompanied by the development of porosity, and a consequent fall in density. After 5000 cycles, the density decreased by 8 per cent. Thermal cycling through both the  $\alpha$ - $\beta$  and  $\beta$ - $\gamma$  phase transformations caused a rapid change in the shape of the uranium specimens, and rapid development of porosity. The drop in density, after 1000 such cycles, was 30 per cent. (auth)

**14566**

BRAZING STAINLESS STEEL TO COPPER. Morris Liebson (U. S. Army Signal and Development Lab., Fort Monmouth, N. J.). Rev. Sci. Instr. **30**, 369-70 (1959) May.

A requirement often encountered in electron tube developmental work is the joining of copper to stainless steel. The usual methods of performing such brazes require that a protective nickel coating first be applied to the stainless steel and that the subsequent brazing operation be carried out in dry hydrogen. An alternative method not requiring hydrogen, prior to nickel plating, or fluxing is described. This new technique has been applied only to the formation of butt joints. (A.C.)

**14567**

COPPER WELDING FOR MAXIMUM RF CONDUCTIVITY. E. F. McLaughlin (Univ. of California, Berkeley). Rev. Sci. Instr. **30**, 372-3(1959) May.

Tests were made to discover economical techniques for producing copper welds for maximum r-f conductivity in connection with the proposed construction of copper-clad steel vacuum tanks for the heavy-ion linear accelerator (HILAC). It was found that welds meeting the design requirement can be rapidly and cheaply produced by the inert-gas-shielded consumable-electrode arc-welding process. The shielding gas may be either helium or argon. (A.C.)

**14568**

ON THE CONNECTION BETWEEN STRUCTURAL AND MAGNETIC PARAMETERS OF THE TRANSITION



METALS. F. M. Galperin. Zhur. Eksptl'. i Teoret. Fiz. 36, 1212-23(1959) Apr. (In Russian)

The connection between the structural parameters (lattice type, interatomic distances, coordination number, etc.) and the magnetic parameters (atomic magnetic moment, the Curie point, and Curie constant) is considered for pure transition elements Cr, Mn, Fe, Co, and Ni as well as for a number of their ferromagnetic ordered alloys and chemical compounds. Semi-empirical quantitative relations expressing this connection are proposed. With the aid of these relations and of the available experimental data on the crystal and electronic structures of metals the magnetic parameters are computed and found to be in good agreement with the experiments. (auth)

#### 14569

THERMODYNAMIC PROPERTIES OF LIQUID METALLIC SOLUTIONS OF POTASSIUM WITH BISMUTH. M. F. Lantratov and M. I. Solov'eva (U'yanov Leningrad Electrotechnical Inst., USSR). Zhur. Priklad. Khim. 32, 304-8(1959) Feb. (In Russian)

The thermodynamic properties of liquid solutions of K-Bi at 575°C were determined by the electromotive method. The data showed strong negative deviations from ideal solutions caused by strong interaction of the components. (R.V.J.)

#### 14570

ATMOSPHERIC CORROSION OF ROLLED FERROUS METALS AT BELOW ZERO TEMPERATURES. I. P. Kharlamov and G. N. Mekhovshchikova. Zhur. Priklad. Khim. 32, 443-4(1959) Feb. (In Russian)

Continuous tests conducted with low-carbon steel showed that atmospheric corrosion of rolled ferrous metals is much slower at sub-zero temperatures. (R.V.J.)

#### 14571

A NEW METHOD FOR PREPARING WARES (PLATES, PIPES, RODS, DIFFERENT PROFILES, ETC.) DIRECTLY FROM THE MELTED SUBSTANCE. [PART] I. A. V. Stepanov. Zhur. Tekh. Fiz. 29, 381-93(1959) Mar. (In Russian)

A method is suggested for preparing various objects directly from liquid metals and alloys by special crystallization of the material. Data are given from experiments made with Al, brass, Cu, Duralumin, Fe, Mg, Ni, and Zn. (R.V.J.)

#### 14572

A NEW METHOD FOR PREPARING WARES (PLATES, PIPES, RODS, DIFFERENT PROFILES, ETC.) DIRECTLY FROM THE MELTED SUBSTANCE. [PART] II. A. L. Shakh-Budagov and A.V. Stepanov. Zhur. Tekh. Fiz. 29, 394-405(1959) Mar. (In Russian)

Descriptions are given of experiments carried out by the previously described method for preparing metal blades and rods directly from liquid metals. The properties of the prepared objects were tested and the results showed satisfactory results. (R.V.J.)

#### 14573

MANUFACTURE OF COMPOSITE BODIES, COMPRISING A METALLIC COMPONENT AND A COMPONENT OF POROUS MATERIAL. J. J. Norreys and General Electric Co., Ltd. British Patent 802,086. Nuclear Eng. 4, 238(1959) May.

A graphite block is placed on the surface of an article of mild steel or low-alloy steel, and a load of 2 tons/in.<sup>2</sup> is applied to the graphite block. The assembly is heated in an atmosphere of pure carbon dioxide at 575°C for

200 hours. A strongly bonded composite body is obtained as a result.

#### 14574

URANIUM ALLOYS. A. U. Seybolt. British Patent 802,147. Nuclear Eng. 4, 238(1959) May.

A uranium alloy containing 0.1 to 10% by weight of Zr or Nb will give a satisfactory fuel material for use in reactors, in quantities not appreciably larger than that of pure U. The compound shows considerable increase in corrosion resistance and hardness, which in the case of a 5% Nb alloy would rise after suitable heat treatment to 71 Rockwell A, as compared with 50 Rockwell A for pure U. Both U and Nb have a neutron capture cross section at thermal energies below that of natural U.

#### 14575

PRODUCTION OF BERYLLIUM. L. J. Derham and U. K. Atomic Energy Authority. British Patent 802,470. Nuclear Eng. 4, 238(1959) May.

Reference is made to B.P. 781,100 describing a method of producing beryllium whereby previously crushed beryllium fluoride and finely divided magnesium are compacted in stoichiometric proportions into briquettes of about 2 in. diameter and 1 in. depth. The briquettes are placed into a bath of molten calcium chloride, the vessel holding the calcium chloride being sealed afterwards and the contents being heated at elevated temperature for a period of one to two hours. Subsequently, it has been found that the success of the method is not restricted to the use of molten calcium chloride as a material for the bath. According to the present application other suitable melt materials are: magnesium chloride, sodium chloride, mixtures of sodium and magnesium chlorides, mixtures of beryllium and calcium chlorides, and mixtures of calcium and sodium fluorides.

## PARTICLE ACCELERATORS AND HIGH-VOLTAGE MACHINES

#### 14576 CERN-59-21

European Organization for Nuclear Research, Geneva. REPORT ON SLOW EJECTION SYSTEM 25 GEV PROTON-SYNCHROTRON. F. Krienlen. May 14, 1959. 29p.

A description is given of a system which proposes to eject the protons from the synchrotron during a relatively long time (10 ms). There are four basic elements involved: beamkicker, thin target, small deflecting magnet, and large deflecting magnet. The system follows variations in the beam condition from pulse to pulse, and is monitored to give substantially constant output. (auth)

#### 14577 AEC-tr-3704

A THEORY ON THE LINEAR ELECTRON ACCELERATOR. H. Leboutet. Translated for Los Alamos Scientific Lab. from Ann. radioélectr. 13, 107-29(1958). 30p. \$6.30(ph), \$3.00(mf) JCL.

The conditions of interaction between a beam and a H. F. wave in a linear accelerator are very similar to those in a traveling wave tube, when the beam is not relativistic, and substantially different when it is, and there is no velocity modulation. The conditions of interaction are examined in both cases, and it is found

in particular that a linear accelerator can be considered as a conventional generator possessing, for a given adjustment, an electro-motive force and an internal impedance which can be calculated. In application, calculations are made of the production of neutrons by a linear accelerator bombarding with electrons a uranium target. (auth)

**14578**

SATURNE, THE PROTON SYNCHROTRON OF THE CEN AT SACLAY. R. Lévy-Mandel (Institut d'Electrotechnique and Centre d'Études Nucléaires, Grenoble, France). *Inds. atomiques* 3, No. 3/4, 47-54(1959). (In French)

The cycle of Saturne, in the course of which the energy of injected protons is raised to 2.5 Bev, lasts approximately 0.9 sec and is repeated every 3.2 sec. The principal mechanisms of this cycle are examined and include the alignment and focusing, injection, and acceleration. (J.S.R.)

**14579**

A NEGATIVE HYDROGEN ION INJECTOR FOR A TANDEM ELECTROSTATIC ACCELERATOR. L. E. Collins and A. C. Riviere (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). *Nuclear Instr. & Methods* 4, 121-8(1959) Apr.

A brief description is given of the source and accelerating system to be used for injection of negative ions into a tandem electrostatic accelerator. The ion source, which is of the radio frequency type, yields a current of 10  $\mu$ a of negative hydrogen ions. The remainder of the system accelerates the ions under constant focusing conditions. The ion optical requirements for focusing of the first stage of the main accelerator are also discussed and compared with the performance of the injection system. (auth)

**14580**

THE INHARMONIC MOTION OF IONS IN A CYCLOTRON AND THE PHASE DIAGRAM. R. Keller (CERN, Geneva). *Nuclear Instr. & Methods* 4, 181-8(1959) Apr. (In French)

It is shown that the equation of the orbits in a cyclotron and a synchro-cyclotron is identical with that of a pendulum. The equations of motion are then derived for the radius of the orbits and for the phase, for an adiabatic variation, such as occurs in practice. A numerical example is given of the calculation of the maximum energy and of phase bunching for a given cyclotron. To conclude, stochastic acceleration is illustrated by means of a phase diagram. (auth)

**14581**

STATISTICAL MECHANISM OF ELECTRON CAPTURE IN THE BETATRON. M. Seidl (Inst. of Vacuum Electronics, Prague). *Zhur. Eksptl', i Teoret. Fiz.* 36, 1305-6(1959) Apr. (In Russian)

The observed physical picture shows the injected electrons changing from the state of unequilibrium to equilibrium during which the cooling mechanism reduces the beam cross section. Due to the fact that the time of relaxation for establishing statistical equilibrium is larger than one revolution, the number of captured electrons depends on the mean life time of the injected electrons. With a weak injection current the necessary time is increased according to the betatron oscillation and rotation frequency ratio. (R.V.J.)

**PHYSICS AND MATHEMATICS****General****14582 AE-18**

Aktiebolaget Atomenergi, Stockholm.  
THE RESONANCE INTEGRAL OF GOLD. K. Jirlow and E. Johansson. Feb. 1959. 20p.

The resonance activation integral of gold was determined by means of cadmium ratio measurements of thin foils in a neutron beam. Comparison was made with a 1/v detector, and the neutron spectra were measured with a chopper. The resonance integral, RI, is defined

$$\text{as } \int_{0.5}^{\infty} \sigma_r(E) dE/E, \text{ where } \sigma_r(E) \text{ is the difference between}$$

the total absorption cross section and the 1/v part. An experimental value of  $1490 \pm 40$  barns was obtained. RI has also been computed from resonance parameter data with the result  $1529 \pm 70$  barns. (auth)

**14583 AECU-4139**

Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

PROGRESS REPORT NO. 53: FOR PHYSICS, JUNE 1, 1958 THROUGH AUGUST 31, 1958; AND FOR CHEMISTRY, JUNE 1, 1958 THROUGH OCTOBER 31, 1958. 88p. Contracts AT(30-1)-2098 and AT(30-1)-905. \$13.80(ph); \$4.80(mf) OTS.

Among chemical studies are reported investigations of mixed ligand complexes, lower valence states of In, hydroxide and cyanide complexes of lead, tungstate equilibria, niobium electrochemistry, and reactions in fused salt media. Instrumental and theoretical studies are represented by flame photometry, photometric titrations, coulometry, millicoulometry, silver electrode potentiometry, hanging drop polarography, irreversible electrode reactions, luminescence spectrophotometry, and gas chromatography. In the Nuclear Chemistry (Inorganic) Group, a major effort is being expended on the study of water and electrolyte uptake of ion-exchange resins. Interest continues in the decay properties of short lived nuclides, especially of the fission products. Two separate studies are in progress on the fission process, one on the distribution of nuclear charge in the fission of  $U^{235}$  with deuterons and  $\alpha$  particles, and one on the separation and estimation of Kr and Xe fission products. In the Nuclear Chemistry (Organic) Group, work is in progress on the rate of reaction of triphenylmethyl chloride with tritium-labeled methanol in benzene solution, the mechanism of enolization of ketones, tritium isotope effect in the reaction of benzoyl peroxide with hexaphenylethane in benzene-t at 25°, interchange of oxygens in triphenylmethyl benzoate under ionizing conditions, the structure of water solutions of methyl halides, isotope effects on the nucleophilic reactivity of anions in the decomposition of sulfonium salts, the mechanism of the Cannizzaro reaction, decomposition of peroxygen compounds, the Bamford-Stevens reaction in  $D_2O$ , and stereospecificity in free radical chain reactions. Progress on work programs in the Cosmic Ray Group is indicated. Results from an analysis of cloud chamber pictures on the helicity of the protons from  $\lambda^0$  decay are summarized. A Forbush decrease was detected on July 8, 1958 with the large meson monitor. Instruments for measuring extensive air showers, low-energy cosmic gamma rays, and the  $\lambda^0$  gyromagnetic



ratio are described. In the High Energy Accelerator Physics Group, work is reported on a study of n-p and p-p pairs in a complex nucleus via  $\pi^-$  capture and measurement of  $K^+$  scattering on protons and neutrons using a beam from the Berkeley Bevatron. The Linear Accelerator Group has been investigating the beam characteristics of the electron gun at the entrance of the linac. The work of the Rockefeller Generator Group was concerned with adaption of the generator to pulsed operation together with the development of associated electronic equipment and continuation of "g" factor investigations. The ONR Generator Group bombarded natural titanium targets with 6.0 and 6.5 Mev protons, and spectra of protons and  $\alpha$  particles emitted at 30, 60, and 90 degrees were analyzed. Using the method of magnetic h.f.s. polarization the Radioactivity Group oriented the nuclei  $Co^{58}$ ,  $Co^{60}$ , and  $Mn^{56}$  in the solid state. The angular distribution of the gamma rays emitted from the polarized nuclei was observed. A series of measurements was completed by the Cyclotron Group on the polarization of 7.5-Mev protons from C, Al, Cu, and Ni. The angular distributions for deuteron elastic scattering from Ni, Nb, Rh, Pd, and Sn were obtained. Several ( $\alpha, d$ ) ground state to ground state angular distributions were measured using a very thin NaI crystal spectrometer. The Theoretical Group has become more and more interested in the many-body problem. Contribution in this direction has been made in the field of nuclear reactions; and in the theory of nuclear matter; and in the theory of superfluidity. There has been a continuing work in the energy levels of nuclei and meson theories. (For preceding period see AECU-3772.) (W.D.M.)

#### 14584 AECU-4172

Brown Univ., Providence. Metals Research Lab. TRANSVERSE ELASTIC WAVE SCATTERING CROSS SECTION FOR SPHERICAL OBSTACLES IN THE RAYLEIGH LIMIT. Edward J. Witterholt, Norman G. Einspruch, and Rohn Truell. May 1, 1959. 24p. Contracts DA-19-020-ORD-4830 and AT(30-1)-1772. \$4.80 (ph), \$2.70 (mf) OTS.

The analytical solutions obtained by Einspruch and Truell for the problem of scattering of a plane transverse elastic wave by a spherical obstacle are analyzed in the Rayleigh limit ( $ka \ll 1$ ). The obstacles considered are: (a) rigid sphere, (b) cavity, and (c) elastic material of properties different from those of the surrounding medium. The scattering cross section for each case is evaluated, and the results are compared with previous work by Ying and Truell on scattering of longitudinal waves. The classical fourth-power frequency dependence of the scattering cross section is obtained. (auth)

#### 14585 AERE-HP/R-1001

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

ABSORPTION IN LEAD OF THE GAMMA RADIATION FROM IRRADIATED URANIUM SLUGS. D. V. Booker and E. M. Flew. Aug. 15, 1952. 19p.

The absorption of the gamma radiation from two uranium slugs irradiated in BEPO for 781 days at an average power in the slug of 132 watts and for 20.5 days at an average power in the slug of 385 watts, respectively, was measured in lead. The results are given in three series of curves, showing gamma dosage against cooling time for different thicknesses of lead shield, fraction of gamma dosage transmitted, i.e.,  $I/I_0$ , against thickness of lead shield for different cooling times and

thickness of lead shield required to give absorption factors of 10, 100, and 1000 against cooling time as deduced from the experimental results. Graphs are also plotted of the calculated curves of fission products in the energy ranges 0 to 0.5, 0.5 to 1.0, 1.0 to 1.6, and  $> 1.6$  Mev, and the average energy for different cooling times. A table is given of the calculated average self absorption in the slugs at various cooling times. (auth)

#### 14586 AERE-R/R-2774

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

AN EXPERIMENTAL DETERMINATION OF THE INCREASE WITH TEMPERATURE OF THE RESONANCE ABSORPTION IN URANIUM AND THORIUM. V. G. Small. Apr. 1959. 28p. \$0.63 (BIS).

Measurements were made with the DIMPLE pile oscillator of the change in the effective resonance absorption integrals of uranium and thorium bars of various diameters produced by heating the bars to temperatures up to 270°C. The experimental data are interpreted in terms of Doppler temperature coefficients of the resonance integral. The results are presented in terms of the surface to mass ratios of the bars, and in the case of uranium a tendency to increased Doppler coefficient with decreasing bar diameter is observed. (auth)

#### 14587 AFMDC-TR-59-4

Air Force Missile Development Center, Holloman AFB, N. Mex.

RELATIVISTIC TREATMENT OF ROCKET PROPULSION WITH FAST PARTICLES AND PHOTONS TAKING INTO CONSIDERATION NUCLEAR DATA. T[rutz] Foelsche. Mar. 1959. 26p. (AD-209328).

Treating rocket kinematics and propulsion according to the concept of the special theory of relativity, it follows that high end velocities of a rocket can be attained only by using a fuel with a high conversion factor of mass into energy. Only normal matter is available in sufficient amounts, and it reacts with a maximum mass conversion factor of only 9/1000 for nuclear-physical reasons. This fact limits the end velocity of a rocket to a few tenths of the velocity of light, so that relativistic velocities and an essential time dilatation cannot be attained. (auth)

#### 14588 AFMDC-TN-59-7

Air Force Missile Development Center, Holloman AFB, N. Mex.

ESTIMATE OF THE SPECIFIC IONIZATION CAUSED BY HEAVY COSMIC RAY PRIMARIES IN TISSUE OR WATER. T[rutz] Foelsche. Dec. 5, 1958. 23p. (AD-212421).

The specific ionization caused by the primary particles of carbon, neon, iron, and niobium along their paths in water is calculated by use of the formulae of Bohr, Bethe, and Bloch, for the average stopping power. The maximum specific ionization and shape and also half width of the maximum on the end of the path of the particles is estimated according to the considerations about capture and loss of electrons made by Bohr, Brunings, Knipp and Teller, and Bell. (auth)

#### 14589 AFOSR-TN-59-264

General Electric Co. Flight Propulsion Lab. Dept., Cincinnati.

NITROGEN AT HIGH TEMPERATURES. Frank Martinek. [1959]. 53p. Contract AF49(638)-243. (AD-212467).

Presented at ASME High-Temperature Symposium, Purdue Univ., Feb. 1959.

The basic thermodynamic properties of pure nitrogen at high temperatures are presented. Internal energy, enthalpy, entropy, electron density, and electrical conductivity are given in engineering units for the temperature range from 5000 to 30,000°K, and pressures varying from 0.2 to 100 atm. The temperature and pressure dependency of dissociation and ionization are also shown. All calculations are based on statistical thermodynamics. (auth)

**14590** AFOSR-TN-59-404

Purdue Univ., Lafayette, Ind.

REFLECTANCE SPECTRA OF PRASEODYMIUM OXIDES IN THE RANGE  $\text{Pr}_2\text{O}_3$  TO  $\text{Pr}_6\text{O}_{11}$ . F. Vratny, M. Tsai, and J. M. Honig. Mar. 1958. 11p. Contract AF18(603)-45. (AD-214524).

The spectra of praseodymium oxides ( $\text{PrO}_x$ ) were studied in the composition range  $1.5 \leq x \leq 1.83$  from 200 to 2000 m $\mu$ . An ultraviolet cut-off was observed at about 320 m $\mu$ , exciton interaction was observed in the spectral range of 400-650 m $\mu$ , and a band was observed in the near infrared which begins at about 900 m $\mu$ . The spectra are discussed in terms of known changes in the crystalline structure of the material. (auth)

**14591** ANL-5995

Argonne National Lab., Lemont, Ill.

GEORGE PROGRAMMING MANUAL. Loretta Kassel, with Appendices by Donald A. Flanders. May 1959. 182p. Contract W-31-109-eng-38. \$3.00(OTS).

GEORGE is an automatic high-speed electronic digital computer designed and constructed by ANL. Operating features of GEORGE are described, and a practical set of instructions is given that will enable a prospective user to construct codes, operate the machine and its auxiliary equipment, use the basic routines available in the routine library, and decide whether a particular problem is suitable on the basis of capacity, speed, and auxiliary equipment. (W.D.M.)

**14592** APEX-246

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

CELL CORRECTION AND LEAKAGE FOR FINITE CYLINDERS. T. J. Kostigen. Feb. 13, 1956. Decl. May 20, 1959. 24p. (DC-56-2-72). \$4.80(ph), \$2.70(mf) OTS.

The fraction of neutrons which make their first collision and the fraction of neutrons which escape out the ends of a solid finite cylinder containing a uniformly distributed isotropic source were evaluated. The results are given as a function of various parameters. (auth)

**14593** BNL-540

Brookhaven National Lab., Upton, N. Y.

A STUDY OF THE WIND PROFILE IN THE LOWEST 400 FEET OF THE ATMOSPHERE. Progress Report No. 2 [for] January 15, 1958-January 14, 1959. Irving A. Singer and Gilbert S. Raynor. Jan. 1959. 29p. Contract R-65-8-99812 SC-01-91. \$1.00(OTS).

By using mean hourly wind speeds measured over a two-year period on the Brookhaven meteorology tower, values of  $p$ , the exponent of a power law expression for the wind profile, were computed for two height intervals (37 to 150 ft and 150 to 355 ft) and were related to a number of easily obtained meteorological parameters. It was found that the mean wind speed profile shows a systematic relationship to a number of other variables

and that several of these, such as wind speed, lapse rate, gustiness, and time of day, are useful as predictors. The variation of  $p$  for shorter time intervals was studied in a number of typical cases. Theoretical mathematical models were developed to determine how the wind profile might best be described and to evaluate the wind profile in vector rather than scalar form. (auth)

**14594** BNL-553

Brookhaven National Lab., Upton, N. Y.

TABLE FOR CONVERTING PHOTON WAVELENGTH TO PHOTON ENERGY IN ELECTRON VOLTS. May 1959. 8p. \$0.50(OTS).

A table for conversion of photon wave length, tabulated in microns, to photon energy in electron volts is presented. The range 0.050 to 9.99 microns is tabulated. (J.R.D.)

**14595** CERN-59-22

European Organization for Nuclear Research, Geneva. FIELD QUANTIZATION AND TIME REVERSAL IN REAL HILBERT SPACE. E. C. G. Stueckelberg. May 19, 1959. 7p.

The question of why complex numbers occur in physics is considered. In development of the subject the uncertainty principle, invariance, spinors, and the realization of the ring are formulated. (J.R.D.)

**14596** CF-59-4-42

Oak Ridge National Lab., Tenn.

RAPID TRANSIT-A REACTIVITY SURVEY PROGRAM FOR THE IBM-704. C. W. Nestor, Jr. Apr. 14, 1959. 22p. Contract W-7405-eng-26. \$4.80(ph), \$2.70(mf) OTS.

The program described computes the reactivity changes associated with slurry settling in a one-region cylindrical slurry reactor. Nuclear-data computation has been included in the program in order to avoid tedious hand calculations and to reduce the amount of input data required. About 3000 cases may be processed per hour of machine time. Certain modifications to the conventional two-group method and techniques employed in improving the rate of convergence of certain iterative procedures are discussed in detail. Sample input sheets, output sheets and instructions for input data preparation are included. (auth)

**14597** CU-187

Columbia Univ., New York. Pupin Cyclotron Lab. and Columbia Univ., New York. George B. Pegram Lab. ELASTIC SCATTERING OF ALPHA PARTICLES BY  $\text{O}^{16}$ . Lillian Christie McDermott. Apr. 2, 1959. 104p. Contract AT-30-1-Gen-72. \$2.50(OTS).

Absolute cross sections for the elastic scattering by  $\text{O}^{16}$  of alpha particles from a Van de Graaff generator have been measured in a differentially pumped gas scattering chamber. The bombarding energy was varied continuously from 3.7 to 6.5 Mev. The corresponding region of excitation in  $\text{Ne}^{20}$  is between 7.7 and 9.9 Mev. The measurements were made at center of mass angles of 168.9°, 149.4°, 140.8°, 125.3°, and 90.0°. The reaction theory of Wigner and Eisenbud, for the case of elastic scattering of spin 0 by spin 0 particles, is applied in the analysis of the observed resonances above 7.9 Mev to find their spins, parities, resonant energies and widths. The characteristic energies and reduced alpha particle widths are also assigned. Six previously unobserved resonances have been found in this region. Five of these levels at 8.748, 8.898, 9.092, 9.172, and 9.570 Mev are sufficiently well resolved for positive identifi-



cation and assignment of parameters. A probable identification is made in the case of the one unresolved resonance at 8.83 Mev. In addition to these relatively sharp resonances, two very broad overlapping resonances must be postulated in the energy range studied if the data are to be fit by resonance theory. The presence of a third broad resonance seems to be indicated above the energy range included in the data. Approximate values of the parameters of the broad resonances are given. (auth)

**14598** GA-P-48-5

General Atomic Div., General Dynamics Corp.,  
San Diego, Calif.

COMPUTED NEUTRON FLUX SPECTRA IN BORON AND CADMIUM POISONED WATER. M. S. Nelkin. Feb. 3, 1959. 9p. Project No. 48. Contract AT(04-3)-167. \$1.80(ph), \$1.80(mf) OTS.

Sample spectrum calculations are given from computations on the IBM-704. Total and transport cross sections of water vs. energy were calculated. These cross sections are plotted. The total cross section is seen to be in good agreement with experiment. Computed flux spectra are given for two boron solutions and two cadmium solutions. (A.C.)

**14599** IDO-16504

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

CALCULATION OF ISOTOPE PRODUCTION BY THE CYCLIC IRRADIATION OF THORIUM. R. G. Nisle. Mar. 26, 1959. 26p. Contract AT(10-1)-205. \$0.75 (OTS).

Irradiation products of natural Th at flux levels of  $10^{12}$ ,  $10^{13}$ ,  $5 \times 10^{13}$ , and  $10^{14}$  neutrons/cm<sup>2</sup>/sec were calculated by the IBM-650 for the continuous and two cyclic irradiation cases. Production graphs of  $U^{233}$  and  $Pa^{233}$  are given. The calculations show that the eventual production of  $U^{233}$  is not materially altered by cyclical irradiation at fluxes below  $10^{13}$ . At fluxes of  $10^{14}$  the loss in  $U^{233}$  after about 25 MTR cycles is about 4% of what would have been produced in continuous irradiation. It is shown that continuous irradiation is preferable when the first consideration is the production of  $U^{233}$  for later separation from thorium. In a power-breeder system, on the other hand, where energy production is of prime importance, cyclic irradiation is acceptable since the loss in  $U^{233}$  production is more than compensated by an increase in the number of fissions. (auth)

**14600** KAPL-M-GHM-1

Knolls Atomic Power Lab., Schenectady, N. Y.  
THE B.P.D. CODE (MODIFIED S.F.O. CODE). G. H. Miley. Apr. 20, 1959. 19p. Contract W-31-109-Eng-52. \$3.30(ph), \$2.40(mf) OTS.

The Burnable Poison Decay Code is described. It is designed to solve a system of simultaneous first order differential equations, and specifically designed to handle systems such as those encountered in calculation of a burnable poison decay chain. The equations and code are described in terms of several specific decay chains; however, it is applicable to a wide variety of such chains. (J.R.D.)

**14601** LA-2305

Los Alamos Scientific Lab., N. Mex.

QUADRATIC TRANSFORMATIONS. PART I. P. R. Stein, S. M. Ulam, and M. T. Menzel. 158p. Contract W-7405-eng-36. \$3.00(OTS).

The properties of a restricted class of homogeneous

quadratic transformations, with interesting physical and biological analogs, which are called Binary Reaction Systems, are considered. All possible transformations of this class in 3 variables were studied numerically on a computing machine, and the limiting behavior of random initial vectors under iteration of each of these transformations is tabulated. Some examples of 4-variable Binary Reaction Systems are also studied, and a few generalizations of the notion of Binary Reaction System are investigated for particular cases. Some remarks and results concerning the behavior in the large are presented, and examples of the mode of approach to the limit are given. Several of the more interesting phenomena are illustrated graphically. Information on a different class of homogeneous quadratic transformations (of arbitrary dimension) which arise naturally from the study of a simple evolutionary mode is presented in the appendix. For this class of transformations, the limiting behavior of arbitrary vectors under iteration can be given explicitly. (auth)

**14602** MRL-40

Cambridge Univ., England. Cavendish Lab. and Watertown Arsenal. Materials Research Lab., Mass.

NEUTRON MAGNETIC SCATTERING FACTORS IN THE PRESENCE OF EXTINCTION. S. Chandrasekhar and R. J. Weiss. Jan. 1958. 6p.

A scheme is proposed for determining a crystal structure factor in the presence of extinction by the use of polarized x rays. The ability to obtain polarized neutrons offers similar possibilities in ferro- and ferrimagnetic substances. (W.L.H.)

**14603** NAVORD-6136

Naval Ordnance Lab., White Oak, Md.

THE INFLUENCE OF THE ABSORPTION OF RADIATION IN SHOCK TUBE PHENOMENA. Jacob Pomerantz. Aug. 15, 1958. 144p.

A method is developed for finding the influence of radiation absorption on the gas flow variables behind strong shock waves. The effects of the lowering of the ionization potential also are considered. Results are presented for shock waves of about Mach number 17 advancing into argon at densities of  $1/8$ ,  $1/10$ , and  $1/2$  atmosphere. The absorption brings the variables to an essentially constant value in a distance depending on the initial densities. The greater the density, the shorter is this distance, and the closer is the constant value to the initial equilibrium value. (auth)

**14604** NP-7580

Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

QUARTERLY PROGRESS REPORT NO. 53. J. B. Wiesner, G. G. Harvey, and H. J. Zimmermann. Apr. 15, 1959. 228p. Project 3-99-00-100. Contract DA36-039-sc-78108.

This report, the fifty-third in a series of quarterly progress reports issued by the Research Laboratory of Electronics, contains a review of the research activities of the Laboratory for the three-month period ending February 28, 1959. Progress is indicated in the broad fields of physical electronics, microwave gaseous discharges, plasma dynamics, solid-state physics, thermoelectric processes and materials, microwave spectroscopy, nuclear magnetic resonance and hyperfine structure, microwave electronics, atomic beams, physical acoustics, and communications. (For preceding period see NP-7310.) (W.D.M.)

**14605** NRL-5241

Naval Research Lab., Washington, D. C.  
SOME RECENT ADVANCES IN RADIOACTIVE SELF-LUMINOUS AIDS TO NIGHT MILITARY ACTIVITY.  
L. J. Boardman. Oct. 24, 1958. 14p. (PB-151226). \$0.50(OTS).

The characteristics and properties of some recently developed radioactive self-luminous sources of light excited by the radioactive isotope krypton-85 are described. Of particular interest are the railway switch light, the hand lanterns, and flashlights. These are simple, rugged, long-life sources which do not depend upon complicated sources of power that may fail at critical times. The ability of the eye when fully dark adapted to read or work in a dark room with these sources of light has been determined, also, the distances that the sources are visible in the dark, the limit of visibility of the brightest being about 2500 feet. Radioactive hazards are discussed and shown to be negligible. (auth)

**14606** NYO-2351

Rochester, N. Y. Univ.; Brown Univ., Providence and Brookhaven National Lab., Upton, N. Y.  
SOME ASPECTS OF THE COVARIANT TWO-BODY PROBLEM. I. THE BOUND-STATE PROBLEM.  
Susumu Okubo and David Feldman. May 15, 1959. 43p. Contract AT(30-1)-2262. \$7.80(ph), \$3.30(mf) OTS.

A study has been made of the bound states of the Bethe-Salpeter equation for the nucleon-antinucleon system, including the ladder and pair-annihilation diagrams. For simplicity, nucleons and mesons were taken to be scalar, the latter having zero rest mass. Pair effects enter only in S states with the bound states corresponding to the poles of the meson propagator  $D_F'$ . The B-S equation is closely related to the integral equation for the generalized vertex operator  $\Gamma$ ; this has been solved by using an integral-transform method similar to that of Wick and Cutkosky, under the assumption that the nucleon mass is large compared to the binding energy. After performing a self-energy subtraction, the energy eigenvalues are found as a function of the coupling constant. These have the form given by the usual Bohr formula plus corrections. Finally, some comments are made with respect to the extension of the formalism to mesons with non-zero mass and spinor nucleons. (auth)

**14607** NYO-2540

New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center.  
COMBINATORIAL, PROBABILISTIC AND STATISTICAL ASPECTS OF AN  $M \times J$  SCHEDULING PROBLEM.  
J. Heller. Feb. 1, 1959. 93p. Contract AT(30-1)-1480. \$15.30(ph), \$5.40(mf) OTS.

The assembly line scheduling problem is studied in detail from the combinatorial, probabilistic, and statistical points of view. The combinatorial study brings out the fact that although there are many possible schedules there are relatively few different schedule times. Because of this result the limiting distribution of schedule times over the set of all possible schedules is studied and found to be a normal distribution. The statistical sampling problem connected with real time simulation studied from the point of view of statistical decision theory is considered and found to give estimates to the number of samples needed to economically determine a "good" schedule. Experiments on an IBM-704 for problems involving 2 to 10 machines and 20 to 100 objects are simulated and bear out the theory. (auth)

**14608** NYO-8678

New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center.  
SPECIAL BLOCK AND LINE ITERATIONS WITH APPLICATIONS TO LAPLACE AND BIHARMONIC DIFFERENCE EQUATIONS. Herbert B. Keller. Jan. 1, 1959. 25p. Contract AT(30-1)-1480. \$4.80(ph), \$2.70(mf) OTS.

Special iteration procedures for solving linear systems of a particular form are considered. It is proved that the iterations can always be made convergent and some results on improving the rate of convergence are given. The application of these methods to Laplace and biharmonic difference equations is studied. In the former case it is found that the present schemes are inferior to some previously proposed methods. However, for the biharmonic case they may be of practical value. (auth)

**14609** ORNL-2718

Oak Ridge National Lab., Tenn.  
PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING MARCH 10, 1959. J. L. Fowler and E. O. Wollan. June 10, 1959. 88p. Contract W-7405-eng-26. \$2.25(OTS).

The longitudinal polarization of  $P^{32}$  beta rays was measured to an accuracy of about 2% by the method of Mott scattering from gold. The observed momentum spectrum of singly charged  $Li^6$  recoils from the decay of  $He^6$  shows that the Gamow-Teller interaction is predominantly axial-vector. The gamma spectra of  $Rh^{106}$  and  $Ag^{106}$  were investigated with scintillation spectrometers. Levels and transitions in  $Pd^{106}$  are proposed. Measurements of neutron radiative capture cross sections in the kev region were made by a new method involving fast time-of-flight techniques and a large liquid scintillator tank. The total neutron cross section of Be was remeasured from 1.9 to 4.5 Mev. The angular distribution of fragments from the fast-neutron-induced fission of  $U^{235}$  was measured for neutron energies between 420 and 3700 kev. The absolute neutron absorption cross sections of Cu, Zn, Ag, Sb, Au, and Pb were measured at 27 kev by use of a spherical-shell transmission method. Total cross sections of elements in the range of A from 35 to 76 were measured in the energy range from 3 to 30 kev. Resonance parameters were extracted and strength functions calculated. Fast-chopper time-of-flight spectrometer studies were made on enriched samples of  $I^{129}$ ,  $U^{233}$ ,  $U^{234}$ ,  $U^{235}$ ,  $Pu^{240}$ ,  $Lu^{175}$ ,  $Lu^{176}$ ,  $Ta^{180}$ , and  $La^{138}$ , on natural-abundance samples of Ta and La, and on samples of  $Am^{241}$ . The resonances observed were analyzed and compared with theoretical predictions of level spacings. General properties are derived for fundamental-mode thermal neutron distributions in heterogeneous pulsed systems. Nuclear spins of 5 and 4 were measured for  $I^{130}$  and  $I^{132}$  by means of the atomic-beam magnetic-resonance technique. Zeeman data of Blank and wavelength data of Gatterer and Junkes on the spectra of Dy were used with IBM-605 calculated wave numbers on Edlen scale to couple two of the energy-level doublets reported by Paulson and Blank. Infrared spectra obtained for the stable cubic phase, and two metastable phases, of  $NH_3$  and  $ND_3$  are discussed. The results of single-crystal neutron diffraction investigations of the antiferromagnetic structures of  $CrCl_3$  and  $FeCl_3$  are presented. Preliminary neutron diffraction observations on HoN at low temperatures indicate that this compound becomes ferromagnetic below about 20°K and that the  $Ho^{3+}$  ions in



the magnetic lattice have an ordered magnetic moment of  $8.0 \pm 1.0$  Bohr magnetons. Neutron diffraction investigations of metallic cerium at low temperatures and of antiferromagnetism in  $\text{CrF}_2$  and  $\text{CrCl}_2$  are reported. Helium is shown to be a satisfactory filling gas for low-temperature ionization chambers. A theoretical and experimental study of germanium surface barrier counters at low temperatures indicated very satisfactory characteristics. A double focusing, uniform field magnet was designed and constructed for the analysis of charged particles from nuclear reactions. A new time-of-flight measuring apparatus is described which differs from conventional time-to-pulse-amplitude converters in that it produces a d-c output large enough to be fed directly into a multichannel sorting device. (For preceding period see ORNL-2610.) (W.D.M.)

#### 14610 P-1511(RAND)

RAND Corp., Santa Monica, Calif.

POWER FOR SATELLITES. J. H. Huth. Oct. 8, 1958. 11p.

To be presented at the ASME National Aviation Division Symposium, March 10, 1959, in Los Angeles.

Units producing power in the kilowatt range for use in satellites are considered. Use of solar energy is examined as well as batteries and nuclear power supplies. It was concluded that solar energy converters may be developed to produce a few kilowatts; however, for higher power levels, reactors appear to be the best bet. (J.R.D.)

#### 14611 SCR-77

Yerkes Observatory, Williams Pay, Wis.

THEORIES OF AURORAS. Joseph W. Chamberlain. Apr. 1959. 19p. \$0.75(OTS).

A lecture delivered at Sandia Corp. Albuquerque, New Mexico, January 21, 1959.

The theories of the origin of the aurora are discussed from two points of view. The two basic structural types of auroras are described. A discussion is included of radio whistlers. (W.L.H.)

#### 14612 SCTM-22-59(16)

Sandia Corp., Albuquerque, N. Mex.

NEUTRON AND GAMMA EFFECTS IN DILUTE AQUEOUS SOLUTIONS. James R. Barcus. Mar. 16, 1959. 21p. Contract [AT(29-1)-789]. \$0.75(OTS).

When radiations traverse matter, widely varying amounts of energy are transferred in electronic and nuclear interactions which can possibly result in physical or chemical changes. In particular, the chemical reactions which are known to occur during the irradiation of dilute aqueous solutions are assumed to proceed via the radicals produced in the radiation decomposition of water. After obtaining the distributions of charged recoils resulting from neutron and gamma irradiation of such solutions, the fundamental interactions of charged particles with molecules are discussed, and the quantum theory of the interactions is outlined. Mention is made of existing and in-progress work on "track effects" (simultaneous diffusion and recombination of radicals). Finally, a qualitative evaluation of the radical yield is given. (auth)

#### 14613 SCTM-290-58(51)

Sandia Corp., Albuquerque, N. Mex.

A SERIES OF PROGRAMS FOR COMPUTING SOME METEOROLOGICAL FUNCTIONS. G. D. Byrne. Aug. 23, 1958. 103p. Contract AT(29-1)-789. \$16.80 (ph), \$5.70(mf) OTS.

A series of programs for computing various meteor-

ological functions on the ERA 1103A (Univac Scientific) is presented. The functions computed include seasonal mean winds, monthly mean winds, wind shears, and seasonal effect scaling winds, as well as the standard deviations for each of these. Also computed were the Mauchly ellipticity functions, space-time correlation coefficients, seasonal time-lag correlation coefficients, and monthly and seasonal correlation coefficients. The data were from 51 (mostly North American) weather stations, each providing one reading per day at 13 pressure levels (from 950 mb to 30 mb) for a 5-year period. (auth)

#### 14614 NP-tr-243

PHYSICAL PROCESSES IN DIFFUSION PUMPS AND EJECTOR PUMPS. II. THE INTERMIXING OF AIR AND OPERATING VAPOUR, AND PUMPING SPEED. H. G. Nöller. Translated by K. J. Bobin (U.K.A.E.A., Atomic Energy Research Establishment) from Z. Angew. Phys. 7, 225-9(1955). 13p. (Figures omitted.) \$3.30(ph), \$2.40(mf) JCL.

Part III assigned report no. NP-tr-244.

The interpenetration of the operating jet with the exhausted air is examined in relation to pump performance. By study of the streaming properties of the operating vapor, and the calculated depths of penetration, a knowledge of the performance at all speeds may be obtained for intake pressures of 5 mm Hg and lower. The diffusion of air into the vapor is described mathematically, and specific and general equations for pumping speeds are discussed. (J.R.D.)

#### 14615 NP-tr-244

THE PHYSICAL PROCESSES IN DIFFUSION- AND EJECTOR-PUMPS. III. COMPARISON OF OBSERVED AND THEORETICALLY OBTAINED FLOW DIAGRAMS. Horst Kutscher. Translated for U.K.A.E.A., Atomic Energy Research Establishment from Z. angew. Phys. 7, 229-34(1955). 20p. (Figures omitted.) \$3.30(ph), \$2.40(mf) JCL or LC.

Part II assigned report no NP-tr-243.

A comparison was made of observed and theoretically obtained diagrams. The agreement between the experimental flow diagrams and the relevant gasdynamic constructions is demonstrated in general terms by extending an investigation to oil vapor and by exhaustive flow constructions. (J.R.D.)

#### 14616

RADIATION FROM HOT AIR. PART II. SHOCK TUBE STUDY OF ABSOLUTE INTENSITIES. James C. Keck, John C. Camm, Bennett Kivel, and Tunis Wentink, Jr. (Avco Research Lab., Everett, Mass.). Ann. Phys. (N. Y.) 7, 1-38(1959) May.

The radiation emitted by shock-heated oxygen, nitrogen, and air has been studied in the wavelength range 2000 to 10,000 Å at temperatures from 4000 to 9000°K and densities from 0.01 to 10 times standard atmospheric. Both spectroscopic and photometric techniques were employed. The radiation consists of bands from  $\text{O}_2$ ,  $\text{N}_2$ ,  $\text{N}_2^+$ , and NO molecules, lines from O and N atoms and continuum Kramers radiation from  $\text{O}^-$ . Comparison of the experimental results with the theoretical expressions giving the wavelength, temperature and density dependence of the radiation gave electronic  $f$ -numbers for all the bands observed. (auth)

#### 14617

LONGITUDINAL AND TRANSVERSE WAVES IN LORENTZ PLASMA. K. Rawer and K. Suchy (Fernmelde-technische Zentralamt der Deutschen Bundespost,

Breisach/Rhein, and Universität, Marburg/Lahn, Ger.). *Ann. Physik* 3, 155-70(1959). (In German)

A discussion on the triple refraction in inhomogeneous plasma is presented with a consideration of the alternation, reflection, polarization, and behavior at the boundary. (tr-auth)

#### 14618

THE DIFFUSION COOLING EFFECT IN HEAVY WATER. N. G. Sjöstrand (AB Atomenergi, Stockholm). *Arkiv Fysik* 15, 145-6(1959).

In an attempt to find the diffusion parameters of heavy water using the pulsed neutron method, some results on the diffusion cooling coefficient were obtained. Diffusion constants found for pure  $D_2O$  from bucklings for two geometries were  $1.74 \pm 0.06$  and  $1.80 \pm 0.08$ . From this, a diffusion cooling coefficient of  $(4.8 \pm 1.0) \times 10^5 \text{ cm}^4/\text{sec}$  was calculated using the relation  $D = D_0 - (c - d) B^2$ . (T.R.H.)

#### 14619

ON THE THEORY UNDERLYING DIFFUSION MEASUREMENTS WITH PULSED NEUTRON SOURCES. N. G. Sjöstrand (AB Atomenergi, Stockholm). *Arkiv Fysik* 15, 147-58(1959).

Starting from the time-dependent Boltzmann equation some problems relating to measurements with pulsed neutron sources in small geometries are investigated. It is shown that the commonly used formula for the time constant of the fundamental mode of the neutron distribution is only approximate. As a consequence all diffusion cooling coefficients measured up to now are too small by 5 to 30 per cent. Further, the conditions under which the results from pulsed neutron source measurements in small geometries can be applied to a reactor are given, and the boundary conditions to use in the interpretation of such experiments are discussed. (auth)

#### 14620

APPROACH TO THE QUANTUM MECHANICAL MANY-BODY PROBLEM WITH STRONG TWO-PARTICLE INTERACTION. II. Evert Andersén (Inst. of Theoretical Physics, Stockholm). *Arkiv Fysik* 15, 181-92 (1959).

An analysis is made of a one-dimensional system of fermions with Gaussian interaction and with the corresponding simple trial wave function in order to examine how the method works with strong short-range interaction. The one-dimensional case is used as a starting point for extension of the method to the three-dimensional case. Explicit calculations are made for a system of four three-dimensional fermions. A discussion of the application of the same method to the nuclear case is given. (T.R.H.)

#### 14621

SELF-ABSORPTION IN SOURCES PREPARED FOR  $4\pi$  BETA COUNTING. Janet S. Merritt, J. G. V. Taylor, and P. J. Campion (Atomic Energy of Canada, Ltd., Chalk River, Ont.). *Can. J. Chem.* 37, 1109-14(1959) June.

Using the  $4\pi\beta$ - $\gamma$  coincidence method the self-absorption of  $4\pi\beta$  counting sources prepared by a number of source preparation techniques has been measured for the negatron emitters  $Cs^{134}$  (86-keV branch only),  $Nb^{95}$ ,  $Hg^{203}$ ,  $Co^{60}$ ,  $Sc^{46}$ ,  $Rb^{86}$ ,  $Au^{198}$ ,  $Na^{24}$ , and the positron branch of  $Cu^{64}$ . The self-absorption varied from a few tenths of one per cent to about ten per cent for sources with a mean superficial density of  $2 \mu\text{g}/\text{cm}^2$  for most of the nuclides studied. Subsidiary experiments were

carried out to indicate the variation of self-absorption with source superficial density. (auth)

#### 14622

ANOMALOUSLY HIGH HALL'S EFFECT IN THE CHROMIUM-TELLURIUM FERROMAGNETIC ALLOY. I. K. Kikoin, E. M. Buryak, and Yu. A. Muromkin. *Doklady Akad. Nauk S.S.S.R.* 125, 1011-14(1959) Apr. 11. (In Russian)

Investigations of galvanomagnetic effects in ferromagnetic alloys uncovered an abnormally high Hall coefficient in chromium-tellurium alloy (50 at. %). The Hall effect was also investigated at temperatures below and above the Curie point. (R.V.J.)

#### 14623

A NEW METHOD FOR THE LINEARIZATION OF THE HAMILTONIAN OF A FREE PARTICLE. M. M. Al'perin (Ushinskii Odessa State Pedagogical Inst.). *Doklady Akad. Nauk S.S.S.R.* 125, 1183-6(1959) Apr. 21. (In Russian)

A new linearization expression for the Hamiltonian of a free particle in space is developed, and the physical interpretation was found for the M. S. Livshits' postulation in which the energy of a free relativistic particle is considered the number of the Hermitian matrix  $H_p$ . (R.V.J.)

#### 14624

AN X-RAY STUDY OF DENSITY DISTRIBUTION ALONG THE DETONATION FRONT OF GAS MIXTURES. M. A. Rivin, Ya. B. Zel'dovich, V. A. Tsukerman, V. V. Sof'ina, and A. S. Beregovskii (Inst. of Physical Chemistry, Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* 125, 1292-3(1959) Apr. 21. (In Russian)

An x-ray study was made of density distribution along the detonation front in gases using a zirconium anode source and krypton as an absorber gas. Absorption of the zirconium  $K_\alpha$  by the Kr permitted the recording of thin layers in the detonating gases. The density distribution curves show regions in which the density is considerably higher than the calculated densities. The experimental value,  $\rho/\rho_0 \approx 3$ , is somewhat lower due to the fact that the chemical peak region is close to the finite space resolution of the method. The relation of the peak width and the composition and pressure of the gas mixture were not determined. (R.V.J.)

#### 14625

THE DIFFUSION OF RADIOGENIC ARGON IN FELDSPARS. Kh. I. Amirkhanov, S. D. Brandt, and E. N. Bartnitskii (Dagestan Branch of the Academy of Sciences, USSR). *Doklady Akad. Nauk S.S.S.R.* 125, 1345-7(1959) Apr. 21. (In Russian)

The kinetics of  $Ar^{40}$  diffusion was studied in two specimens of Pre-Cambrian feldspar. The ratio of  $Ar^{40}$  before and after heating for specimen No. 1 was 0.962 and for No. 2, 0.992. It was found that specimen No. 1 undergoes three phases; the first phase corresponds to an  $Ar^{40}$  quantity of  $0.370 \text{ nmm}^3/\text{g}$  diffused at temperatures up to  $800^\circ$ ; the second phase at  $900$  to  $1100^\circ$  was  $0.546 \text{ nmm}^3/\text{g}$ , and the third phase (at  $>1100^\circ$ )  $0.046 \text{ nmm}^3/\text{g}$ . The three phases of the second specimen were at  $500$  to  $650^\circ$ ,  $0.206 \text{ nmm}^3/\text{g}$ , second phase at  $700$  to  $1050^\circ$ ,  $0.659 \text{ nmm}^3/\text{g}$ , and third  $>1150^\circ$ ,  $0.067 \text{ nmm}^3/\text{g}$ . (R.V.J.)

#### 14626

NEW POWER SOURCES FOR SPACE-AGE ELECTRONICS. David Linden and Arthur F. Daniel (Army



Research and Development Lab., Fort Monmouth, N. J.). Electronics 32, No. 12, 43-7(1959) Mar. 20.

The various types of portable power sources proposed or being developed or used are described and compared. Solar, nuclear, and chemical devices are compared on weight/watt, longevity or service life, volume/watt, and other bases. (T.R.H.)

#### 14627

THEORY OF ANTIFERROMAGNETISM IN TRANSITION METALS. I. ENERGY SPECTRUM. A. A. Berdyshev and K. V. Shitikova (Gor'kii Ural State Univ., USSR). Fiz. Metal. i Metalloved. 7, 21-8(1959) Jan. (In Russian)

An s-d exchange model for antiferromagnetic transition metals was developed, with consideration for magnetic interactions, and the energy spectrum was investigated. It is shown that the conductance band splits into two bands with a slit between them proportional to the submatrix magnetization. (tr-auth)

#### 14628

HYDROGEN EFFECTS ON STEEL NITRATION. A. A. Yurgenson (Ural Turbine-Motor Plant, USSR). Fiz. Metal. i Metalloved. 7, 110-15(1959) Jan. (In Russian)

Alterations in carbon content of steel after prolonged nitration, the composition of the carbon-nitride phase, and the distribution of carbon in the nitrogen layer were studied in order to determine decarbonization effects of hydrogen during nitration. (R.V.J.)

#### 14629

DETERMINATION OF THE FERMI SURFACE SHAPE OF THE ANGULAR DISTRIBUTION OF  $\gamma$  QUANTA FORMED IN THE ELECTRON-POSITRON PAIR CONVERSION INTO PHOTONS. M. A. Krivoglaз and A. A. Smirnov (Inst. of Metal Physics, Ukraine SSR). Fiz. Metal. i Metalloved. 7, 151-2(1959) Jan. (In Russian)

It is shown that it is possible to determine the magnitude of Fermi energy and the shape of Fermi electrons in metals by studying the photons produced by positron irradiation of metals. A coincidence counter was used in studies of the angular distribution of  $\gamma$  quanta formed by positron irradiation of a small monocrystalline metal specimen. Results show that the method can be used in studies of the shape of the Fermi surface in pure metals and alloys, especially in investigations of Fermi surface changes in phase transitions, in ordering, etc. (R.V.J.)

#### 14630

MICROWAVE MEASUREMENT OF DIELECTRIC PROPERTIES UNDER EXTREME THERMAL ENVIRONMENTS. D. M. Bowie and J. Huminik, Jr. (Melpar, Inc., Falls Church, Va.). Ind. Labs. 10, No. 5, 42-7(1959) May.

The feasibility of short-circuited-line method for evaluating intrinsic dielectric properties of materials under extreme thermal environments including nuclear irradiation is examined. A diagram of an apparatus and electrical features used in such a system is included as well as a chart showing variation of dielectric constant and loss tangent with temperature, for a number of materials consisting mainly of plastic and ceramic mixtures. (J.R.D.)

#### 14631

ATTENUATION OF  $\gamma$  RAY INTENSITY IN PASSING THROUGH COAL. V. D. Goroshko. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo No. 1, 120-2(1959) Jan.-Feb. (In Russian)

The attenuation of various energy gamma rays by

carbon mixtures was tested with specially prepared natural coal and pyritic-coal bricks, 50 mm in diameter and 25 to 150 mm thick; also, with coal fines of 0 to 3 mm with various admixtures. The isotopes  $\text{Co}^{60}$  ( $E = 1.17$  and  $1.33$  Mev),  $\text{Cs}^{137}$  ( $E = 0.66$  Mev),  $\text{Si}^{75}$  ( $E = 0.07$  to  $0.4$  Mev), and  $\text{Tm}^{170}$  ( $E = 0.085$  Mev) were used as  $\gamma$  sources. Diagrams were plotted for intensity curves. (R.V.J.)

#### 14632

SHOCK WAVES REFLECTED BY MAGNETIC FIELDS. William R. Atkinson, William R. Holden, and Richard G. Fowler (Univ. of Oklahoma, Norman). J. Appl. Phys. 30, 801-2(1959) June.

Fast moving plasmas encountering transverse magnetic fields of order  $10^4$  gauss are decelerated so rapidly as to produce reflected shock waves. Observations in hydrogen at gas pressures of 1 to about 10 mm Hg are analyzed. There are critical conditions of magnetic field for the onset of the reflection. The velocities of the advancing and reflected waves are recorded as a function of pressure and field. (auth)

#### 14633

AXIALLY SYMMETRIC ELECTRON BEAMS OF UNIFORM AXIAL VELOCITY. Edward J. Cook (General Electric Research Lab., Schenectady, N. Y.). J. Appl. Phys. 30, 860-5(1959) June.

The general member of the class of long, dense electron beams with a uniform velocity profile is derived. Various special cases become the equilibrium systems of current interest. In addition to these known systems, the analysis leads to new possibilities. One of these is of particular interest in that it is the first of this group of beams in which the axial velocity is important to the balance of forces on the electrons. The new beam has properties ideal for M-type interaction and should be of considerable future importance. (auth)

#### 14634

CALCULATION OF THE INTENSITY OF SMALL-ANGLE X-RAY SCATTERING AT RELATIVELY LARGE SCATTERING ANGLES. Paul W. Schmidt and Robert Hight, Jr. (Univ. of Missouri, Columbia). J. Appl. Phys. 30, 866-71(1959) June.

Since the small-angle x-ray scattering intensity can be expressed as a Fourier integral, the techniques of asymptotic expansion of Fourier integrals can be used to calculate the small-angle x-ray scattering at relatively large scattering angles. Some asymptotic expansion techniques which are often useful are described. The relation between the scattered intensity at relatively large angles and the characteristic function and its derivatives is discussed. The scattered intensity for both prolate and oblate ellipsoids of revolution is calculated to provide examples of asymptotic expansion methods, and the resulting expressions are evaluated numerically. The behavior of the scattered intensity at relatively large scattering angles for platelet particles of negligible thickness is described. (auth)

#### 14635

MEASUREMENT OF THE ANGULAR DISTRIBUTION OF ELECTRONS EJECTED FROM TUNGSTEN BY HELIUM IONS. Robert C. Abbott and H. W. Berry (Syracuse Univ., N. Y.). J. Appl. Phys. 30, 871-3(1959) June.

Rotating collector measurements, made at a pressure of  $10^{-6}$  mm Hg, yielded cosine distributions for all experimental conditions. Data were obtained for gas-covered and partly gas-covered target surfaces, for

several beam incidence angles, and for ion energies of 40, 400, and 825 eV. It is postulated that the identical cosine distributions observed for both kinetic and potential ejection are caused by the existence of isotropic angular distributions for both mechanisms within the metal. A general expression is given for the angular distribution of emission from an arbitrarily shaped surface. This expression is a function of the fundamental angular distribution associated with a single element of area on that surface and the orientation distribution of the elements of area. (auth)

#### 14636

REACTOR PHYSICS FOR THE ELECTRICAL ENGINEER. PART II. J. C. James. *Nuclear Eng.* **4**, 216-19(1959) May.

The close parallelism of the fundamental quantities of reactor physics with electrical science is extended to the basic functional characteristics of the complete reactor circuit. The reactor system is likened to a d-c shunt generator, and it is shown how perturbations of the reactor depend on the analog of power and how the transient behavior may be described by comparing delayed neutron production with inductance. (J.R.D.)

#### 14637

A METHOD FOR THE PREPARATION OF VERY THIN FOILS. E. Kashy, R. R. Perry, and J. R. Risser (Rice Inst., Houston, Texas). *Nuclear Instr. & Methods* **4**, 167-70(1959) Apr.

A method for the preparation of self-supporting carbon foils of thicknesses ranging between 4 micrograms per cm<sup>2</sup> and 30 micrograms per cm<sup>2</sup> and of areas ranging between 0.25 cm<sup>2</sup> and 1 cm<sup>2</sup> is outlined. The essential features of the method are such that its application is not restricted to carbon. (auth)

#### 14638

COSMIC RAY CUT-OFF RIGIDITIES AND THE EARTH'S MAGNETIC FIELD. J. J. Quenby and W. R. Webber (Imperial Coll. of Science and Tech., London). *Phil. Mag.* (8) **4**, 90-113(1959) Jan.

Approximate values of the vertical cut-off rigidities for cosmic ray particles in the earth's magnetic field have been deduced taking into account both the dipole and the non-dipole parts of the internal field. The accuracy of these calculated values is discussed and it is shown that they fit the experimental data rather well. (auth)

#### 14639

EXCITATIONS IN LIQUID HELIUM: NEUTRON SCATTERING MEASUREMENTS. J. L. Yarnell, G. P. Arnold, P. J. Bendt, and E. C. Kerr (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **113**, 1379-86(1959) Mar. 15.

The energy-momentum spectrum of the excitations in liquid helium II was measured in a neutron scattering experiment. At  $T = 1.1^\circ\text{K}$ , data were obtained in the momentum range  $p/\hbar = 0.55$  to  $2.36 \text{ \AA}^{-1}$ . The results bear a striking resemblance to the spectrum proposed by Landau in 1947. If a phonon spectrum of the form  $E = v_1 p$  is fitted to the point at  $p/\hbar = 0.55 \text{ \AA}^{-1}$ , a value of  $239 \pm 5$  meters/sec is obtained for  $v_1$ . The measured spectrum passes through a maximum of  $E/k = 13.92 \pm 0.10^\circ\text{K}$  at  $p/\hbar = 1.11 \pm 0.02 \text{ \AA}^{-1}$ . There is a minimum at  $p/\hbar = 1.92 \pm 0.01 \text{ \AA}^{-1}$ , which may be represented by Landau's roton expression,  $E = \Delta + (p - p_0)^2/2\mu$ , with  $\Delta/k = 8.65 \pm 0.04^\circ\text{K}$ ,  $p_0/\hbar = 1.92 \pm 0.01 \text{ \AA}^{-1}$ ,  $\mu = (0.16 \pm 0.01)m_{\text{He}}$ . Above  $p/\hbar = 2.18 \text{ \AA}^{-1}$ , the spectrum rises linearly with a slope corresponding to the velocity of

first sound. Data were obtained in the region of the minimum at  $T = 1.6^\circ\text{K}$  and at  $T = 1.8^\circ\text{K}$ . The spectrum has the same general shape observed at  $T = 1.1^\circ\text{K}$ , shifted downward by  $0.22^\circ\text{K}$  at  $1.6^\circ\text{K}$ , and by  $0.50^\circ\text{K}$  at  $1.8^\circ\text{K}$ . The temperature variation may be represented by the empirical expression  $\Delta/k = 8.68 - 0.0084T^\circ\text{K}$ . At the higher temperatures, the energy spread of the excitations was larger than the energy resolution of the apparatus. The observed full width at half maximum was  $\sim 1^\circ\text{K}$  at  $T = 1.6^\circ\text{K}$ , and  $\sim 2^\circ\text{K}$  at  $T = 1.8^\circ\text{K}$ . (auth)

#### 14640

EXCITATIONS IN LIQUID HELIUM: THERMODYNAMIC CALCULATIONS. P. J. Bendt, R. D. Cowan, and J. L. Yarnell (Los Alamos Scientific Lab., N. Mex.). *Phys. Rev.* **113**, 1386-95(1959) Mar. 15.

The entropy, specific heat, normal fluid density, and velocity of second sound in liquid helium II were calculated by applying statistical mechanics to the thermal excitations. The calculations were based on the energy-momentum relation obtained by neutron scattering measurements described by Yarnell, Arnold, Bendt, and Kerr, and were made on an IBM-704 electronic digital computer by numerical integrations over the observed excitation curve. A better approximation than Landau's was obtained by extending Landau's theory to take account of the temperature dependence of the excitation curve. An expression of the form  $E(p, T) = c - d(\rho_n/\rho)$  was used to interpolate the excitation energy between temperatures at which it was measured. Results between  $0.2$  and  $1.8^\circ\text{K}$  are not sensitive to the exact form of the interpolation expression. Agreement of the calculations with experimental measurements is as follows: entropy,  $\pm 3\%$  in the temperature range  $0.2$  to  $1.8^\circ\text{K}$ ; specific heat,  $\pm 4\%$  between  $0.2$  and  $1.7^\circ\text{K}$ ; second sound velocity,  $\pm 4\%$  between  $0.8$  and  $1.8^\circ\text{K}$ , and  $\pm 2\%$  between  $1.0$  and  $1.7^\circ\text{K}$ . The calculated normal fluid density  $\rho_n$  agrees with experimental values derived from second sound velocity and specific heat measurements within  $\pm 8\%$  between  $0.7$  and  $2.0^\circ\text{K}$ , and within  $\pm 5\%$  from  $1.1$  to  $1.9^\circ\text{K}$ . These values are, however, higher than those obtained from torsion pendulum measurements, which are  $27\%$  below the calculated value at  $1.2^\circ\text{K}$ . Also calculated as functions of temperature are the average effective mass (as defined by Landau) of excitations in four momentum intervals, and values of  $-\kappa/B$ , the thermal conductivity  $\kappa$  divided by the average over momentum of the Khalatnikov nonequilibrium kinetic coefficient  $-B$ , and  $\eta/\bar{C}$ , the viscosity  $\eta$  divided by the average value of the Khalatnikov coefficient  $C$ . (auth)

#### 14641

COULOMB SCATTERING IN A VERY STRONG MAGNETIC FIELD. L. M. Tannenwald (Lockheed Aircraft Corp., Palo Alto, Calif.). *Phys. Rev.* **113**, 1396-1405(1959) Mar. 15.

The spiralling of charged particles in an intense magnetic field is taken into account in the description of their collisions involving small fractional momentum transfer. The transition probability to the continuum of possible states is given. In addition, the transition probability is given for a particle's orbit center to be displaced from one magnetic line of force to another, with accompanying momentum change, as a result of scattering by a fixed charge. The equivalent results are derived for the scattering of two identical particles in their relative coordinate system. As the result of scattering, the momentum change along the magnetic field in a uniform, collimated beam of spiralling particles is found to be very much smaller than the sum of the mag-



nitudes of the individual momentum changes in that direction. In contrast to ordinary Coulomb scattering, one finds that there is a lower limit to the momentum transfer to individual particles and that there is an adiabatic cutoff distance associated with the interaction which, in some plasma situations, can be shorter than the value of the Debye distance. The WKB approximation for generalized Laguerre polynomials is appended. (auth)

**14642**

LOW-TEMPERATURE BEHAVIOR OF A DILUTE BOSE SYSTEM OF HARD SPHERES. II. NONEQUILIBRIUM PROPERTIES. T. D. Lee (Columbia Univ., New York) and C. N. Yang (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. **113**, 1406-13(1959) Mar. 15.

The calculation of a previous paper is extended to cover nonequilibrium properties. The phenomena of superfluidity, critical velocity, and "infinite heat conductivity" are given natural explanations. By using classical kinetic theory on the wave packets, hydrodynamical equations for reversible flow are derived and the dependence of the two "sound velocities" on the temperature studied. The relationship between macroscopic sound vibrations and microscopic excitations is analyzed. The work is confined to the model of a dilute hard-sphere Bose system. (auth)

**14643**

RELATIVISTIC HYDRODYNAMICS FOR A CHARGED NONVISCIOUS FLUID. Chau-Chin Wei (Taiwan Power Co., Taipei). Phys. Rev. **113**, 1414(1959) Mar. 15.

The equations of relativistic hydrodynamics are derived from an alternative variational method and a generalized vorticity equation is obtained. (auth)

**14644**

X-RAY INCOHERENT SCATTERING FUNCTION OF ATOMS BASED ON THE THOMAS-FERMI THEORY. T. Tietz (Univ. of Lodz, Poland). Phys. Rev. **113**, 1521-2(1959) Mar. 15.

A simplified method of calculating the x-ray incoherent scattering function, which appears in the Thomas-Fermi theory, is given. Values obtained for the incoherent scattering function by this method are compared with the corresponding numerical values of Bewilogua. (auth)

**14645**

MULTIPLE-QUANTUM TRANSITIONS IN NUCLEAR MAGNETIC RESONANCE. Shaul Yatsiv (Stanford Univ., Calif.). Phys. Rev. **113**, 1522-37(1959) Mar. 15.

The theory of Bloch and Wangsness for nuclear magnetic resonance signals is applied to multiple-quantum transitions. In most of the NMR experiments, the energy level schemes are only slightly different from an equally spaced Zeeman pattern, so that a simultaneous absorption of several radiation quanta with the same frequency can take place. It is found that the multiplicity, or the number of quanta absorbed in the transition, is most easily determined through the specific dependence of the multiple quantum signals on the rf field amplitude. The dependence of the signals on various relaxation parameters is developed and is found to provide information about relaxation processes which is not derivable from ordinary single-quantum transitions. A method of enhancing multiple transitions by audio-modulating the radio-frequency field is described. This is helpful in cases where the frequency deviations from an equally spaced Zeeman pattern are so large that a direct multiple transition is too weak to be observed. (auth)

**14646**

FORMATION OF POSITRONIUM IN AN ELECTRON GAS. M. A. B. Bég and P. M. Stehle (Univ. of Pittsburgh). Phys. Rev. **113**, 1545-7(1959) Mar. 15.

It is shown that for a positron in a free electron gas, radiationless capture, to form positronium, is very likely prior to annihilation. (auth)

**14647**

THE VELOCITY OF SOUND IN LIQUID HELIUM NEAR THE  $\lambda$  POINT. C. E. Chase (Massachusetts Inst. of Tech., Lincoln Lab., Lexington). Phys. Rev. Letters **2**, 197-9(1959) Mar. 1.

A method of calculating the temperature dependence of  $u_0$  (the velocity of sound in the low-frequency limit) near the  $\lambda$  point is described. The calculation is based on the idea that near a second-order phase transition the entropy and volume surfaces, considered as functions of  $p$  and  $T$ , are cylindrical sections whose generators are parallel to the transition line. (W.D.M.)

**14648**

THEORY OF ELECTRON-PHONON INTERACTIONS. G. D. Whitfield (IBM Watson Lab. [New York] and Columbia Univ., New York). Phys. Rev. Letters **2**, 204-5(1959) Mar. 1.

The theory of the interaction of electrons and acoustic phonons in nonpolar crystals has been formulated in terms of a new set of basis states, whose wave functions are essentially Bloch functions that deform with the lattice. The major part of the interaction may then be calculated in terms of the strain tensor rather than the displacement of the lattice. A result of the theory is a generalization of the deformation potential theorem. A Boltzmann equation for the diagonal elements of the density matrix in orthogonalized deformed Bloch functions representation is derived. (W.D.M.)

**14649**

SPIN-PHONON INTERACTION IN RUBY. N. S. Shiren and E. B. Tucker (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev. Letters **2**, 206-7(1959) Mar. 1.

An attempt was made to observe the spatial transfer of spin temperature in synthetic ruby crystals containing 0.05 and 0.005%  $\text{Cr}_2\text{O}_3$  at 1.7 and 20°K. The experiment consisted of observing the resonance absorption, in one end of a crystal, at a power level well below saturation as a function of the saturation power level applied to the other end. (W.D.M.)

**14650**

PRODUCTION OF POLARIZED PROTON BEAMS. L. Madansky and G. E. Owen (Johns Hopkins Univ., Baltimore). Phys. Rev. Letters **2**, 209-11(1959) Mar. 1.

A method is proposed to produce relatively intense beams of metastable hydrogen atoms and their subsequent ionization. Preliminary experiments indicate the feasibility of the proposed technique. (W.D.M.)

**14651**

HYDRODYNAMICS OF LIQUID HELIUM II. C. C. Lin (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters **2**, 245-6(1959) Mar. 15.

A brief account of macroscopic hydrodynamic theory of liquid helium II which describes most of the experimental observations on the thermal and mechanical behavior of liquid helium below the  $\lambda$  point is given. (A.C.)

**14652**

MAGNETIC FORM FACTOR OF COBALT. R. Nathans (Pennsylvania State Univ., University Park and Brook-

haven National Lab., Upton, N. Y.); and A. Paoletti (Comitato Nazionale Ricerche Nucleari, Rome and Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters **2**, 254-6(1959) Mar. 15.

Preliminary results on the magnetic form factor of the face-centered cubic phase of metallic cobalt which indicate a deviation from spherical symmetry for its 3d electrons are given. The results of the measurements are graphically shown and tabulated. (A.C.)

#### 14653

LATTICE VIBRATIONS IN SILICON BY SCATTERING OF COLD NEUTRONS. H. Palevsky, D. J. Hughes, W. Kley, and E. Tunkelo (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters **2**, 258-9(1959) Mar. 15.

A number of infrared measurements have been made on silicon and used to determine the Raman frequency, the optical vibration of zero phonon momentum. Several experimenters using infrared absorption measurements have given values of  $h\nu$  for the Raman line which are in poor agreement. Measurements of the phonon energy by the cold-neutron method are described and the results are graphically shown. The cold-neutron value for the Raman line is not in agreement with the infrared measurements. (A.C.)

#### 14654

CONTRIBUTION OF THE NUCLEUS TO THE SPECIFIC HEAT OF RHENIUM. P. H. Keesom and C. A. Bryant (Purdue Univ., Lafayette, Ind.). Phys. Rev. Letters **2**, 260-1(1959) Mar. 15.

Measurements of the heat capacity of a rhenium ingot between 0.37 and 4.2°K show an anomalous contribution to the specific heat which is proportional to  $T^{-2}$ . This temperature dependence suggests that contribution is the high-temperature part of a Schottky-type anomaly arising from a set of discrete energy levels. To quench superconductivity and observe the magnetic field dependence of the anomaly, measurements were repeated in a field of about 1000 gauss. The anomaly was influenced by the applied field less than should be expected if it were caused by repopulation of electronic energy levels. There remains the possibility that the energy levels of the nucleus are separated sufficiently to produce the anomaly. (A.C.)

#### 14655

NUCLEAR SPECIFIC HEAT OF GALLIUM AND ZINC. G. Seidel (Univ. of Leiden) and P. H. Keesom (Purdue Univ., Lafayette, Ind.). Phys. Rev. Letters **2**, 261-2(1959) Mar. 15.

Knight et al. measured the pure quadrupole resonance spectra for  $Ga^{69}$  and  $Ga^{71}$  in the metallic state. From their results it is possible to calculate the quadrupole coupling constant for both isotopes and also the contribution of the nuclei to the specific heat of naturally occurring gallium. No departure of the electronic specific heat in the superconducting state from the expected exponential decrease with temperature was observed. Philips observed deviations of the specific heat of  $Zn^{67}$  (spin  $\frac{1}{2}$ ) from the exponential temperature dependence outside experimental error. It is reasonable to assume that these deviations are nuclear in origin and that they have a temperature dependence proportional to  $1/T^2$ . (A.C.)

#### 14656

BREMSSTRAHLUNG FROM DENSE PLASMAS. H. R. Griem (Univ. of Maryland, College Park and Naval Research Lab., Washington, D. C.); and A. C. Kolb and

W. R. Faust (Naval Research Lab., Washington, D. C.). Phys. Rev. Letters **2**, 281-2(1959) Apr. 1.

Bremsstrahlung radiation in the optical and x-ray regions of the spectrum was observed during the magnetic compression of a shock-preheated plasma in a magnetic mirror geometry. Earlier experiments led to the conclusion that electron temperatures of about  $8 \times 10^6$  °K and densities of the order of  $10^{17}$  cm<sup>-3</sup> might be expected during the first half-cycle of the discharge for field strengths of about 100,000 gauss. Experiments were performed with field intensities of 125,000 and 200,000 gauss, respectively, between the magnetic mirrors. Electron temperatures were  $8 \times 10^6$  °K and  $5.5 \times 10^6$  °K, respectively, in good agreement with predicted values. (A.C.)

#### 14657

POSSIBLE DETERMINATION OF THE HELICITY OF ELEMENTARY EXCITATIONS IN LIQUID He II. T. D. Lee and F. Mohling (Columbia Univ., New York). Phys. Rev. Letters **2**, 284-5(1959) Apr. 1.

The energy-momentum curve of the excitations in liquid helium were directly measured by the inelastic scattering of cold neutrons. It is found that associated with a definite momentum transfer of the neutron there is a definite energy transfer. It is customary to call these excitations "phonons" and "rotons." The angular momentum of these excitations is investigated by studying the angular distribution of the scattered neutrons. (A.C.)

#### 14658

DIFFUSIVE MOTIONS IN LIQUIDS AND NEUTRON SCATTERING. B. N. Brockhouse (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev. Letters **2**, 287-9(1959) Apr. 1.

Measurements of neutron inelastic scattering by a classical liquid provide access to the details of atomic motions in the liquid. The partial differential neutron cross sections are Fourier transforms over space and of the time-dependent correlations and are essentially functions only of neutron energy transfer and momentum transfer. The details of these energy transfers give information on the way diffusion occurs. Measurements could not be reconciled with the simple models of diffusion by large jumps only or by diffusion by small motions only. Measurements have now been made at much higher resolution with the new rotating crystal spectrometer (at NRX Reactor). Measurements were made on light and heavy water and ice. (A.C.)

#### 14659

SUPERCONDUCTIVITY OF  $\beta$  MERCURY. J. E. Schirber and C. A. Swenson (Iowa State Coll., Ames). Phys. Rev. Letters **2**, 296-7(1959) Apr. 1.

Solid mercury ordinarily crystallizes in a rhombohedral structure which is stable to absolute zero under normal pressures. Recent experiments have shown that a new type of mercury ( $\beta$ ) can be produced which is actually the more stable form at temperatures below 79°K. Although  $\beta$  mercury is stable at zero pressure below 79°K and metastable for temperatures below 90°K, it can be formed only at relatively high pressures (4000 atm.). The critical field curve to 200 gauss was determined. The critical field curves of  $\alpha$  and  $\beta$  forms of mercury are shown graphically. The results of the investigation show that the structure of  $\beta$  mercury is quite different from that of  $\alpha$  mercury. (A.C.)

#### 14660

RESONANCE PHENOMENA IN LARGE-ANGLE HE-



LIUM ION-HELIUM ATOM COLLISIONS. F. P. Ziemba and E. Everhart (Univ. of Connecticut, Storrs). *Phys. Rev. Letters* **2**, 299-301(1959) Apr. 1.

When  $\text{He}^+$  ions are scattered from He atoms at kev energies, a small fraction of these collisions results in large-angle scattering of the incident particle. Particles from  $\text{He}^+$ -He collisions were analyzed to determine the fractions which were neutral and doubly ionized. These data are shown graphically. (A.C.)

#### 14661

MAGNETIC PERTURBATION ON CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG. A. Bisi and L. Zappa (Istituto di Fisica del Politecnico, Milan). *Phys. Rev. Letters* **2**, 348-9(1959) Apr. 15.

With a view to obtaining further information on the influence of matter on external bremsstrahlung (EB) polarization, the circular polarization-energy relation for EB quanta was investigated by using a magnetized iron target as the  $\beta$  absorber. The circular polarization of  $\gamma$  rays was analyzed through Compton scattering with polarized electrons available in magnetized iron. (W.D.M.)

#### 14662

SATELLITE-MEASURED RADIATION. G. W. Stuart (General Dynamics Corp., San Diego, Calif.). *Phys. Rev. Letters* **2**, 417-18(1959) May 15.

Recent satellite and rocket measurements reveal that above approximately 500 km the earth is surrounded by an intense belt of ionizing radiation. The relevance of atomic charge-exchange processes to the nature of the radiation belt is pointed out. (W.D.M.)

#### 14663

DYNAMIC NUCLEAR POLARIZATION. M. Abraham, M. A. H. McCausland, and F. N. H. Robinson (The Clarendon Lab., Oxford). *Phys. Rev. Letters* **2**, 449-51(1959) June 1.

Saturation of the microwave electron paramagnetic resonance of impurities in various materials produces enhanced and reversed nuclear polarization throughout the material. This effect was investigated and is discussed in some detail for LiF single crystals. Results for other materials at microwave frequencies between 8 and 10 kMc/sec and temperatures between 1.2 and 1.6°K are presented. The variety of materials yielding a measurable effect suggests that this is a very general way of polarizing nuclei. (W.D.M.)

#### 14664

OBSERVATION OF THE  $\text{Co}^{59}$  NUCLEAR MAGNETIC RESONANCE IN PARAMAGNETIC SALTS. R. G. Shulman (Bell Telephone Labs., Murray Hill, N. J.). *Phys. Rev. Letters* **2**, 459-60(1959) June 1.

The possibility of observing the nuclear magnetic resonance signal from the nuclei of magnetic ions in the paramagnetic state has been considered theoretically by Moriya.  $\text{KCoF}_3$  and  $\text{CoO}$  with Néel temperatures of 137 and 293°K, respectively, both with cubic structures, the former being perovskite and the latter NaCl, were considered suitable substances in which to search for the  $\text{Co}^{59}$  resonance. The  $\text{Co}^{59}$  resonance was observed in both substances and the  $\text{KCoF}_3$  is considered in detail. (W.D.M.)

#### 14665

PLASMA PINCH EFFECTS IN INDIUM ANTIMONIDE. M. Glicksman and M. C. Steele (RCA Labs., Princeton, N. J.). *Phys. Rev. Letters* **2**, 461-3(1959) June 1.

In pulsed studies of the properties of n-type indium antimonide at 77°K in high electric fields, some inter-

esting effects were observed in the presence of an external longitudinal magnetic field. It is suggested that these observations indicate the presence of pinching effects for the electron-hole pair current in indium antimonide. Measurements were made on two samples with an electron density of  $2 \times 10^{14} \text{ cm}^{-3}$  at low electric fields. (W.D.M.)

#### 14666

IRREVERSIBLE PROCESSES IN A PLASMA. R. Balescu (Université Libre, Brussels). *Physica* **25**, 324-5(1959) Apr.

The characteristic divergences caused by long-range phenomena in gases can be eliminated in equilibrium situations by partial summations of terms individually divergent but whose sum converges. It is shown how the recently developed diagram technique enables treatment of non-equilibrium cases by a rigorous asymptotic method. The general ideas underlying the approach are briefly indicated. (T.R.H.)

#### 14667

A MEASUREMENT OF THE GAMMA-RAY INTENSITY PRODUCED BY EXTENDED SOURCE. E. E. Kovalev, V. I. Popov, L. N. Smirenniy, and Yu. S. Khokhlov. *Reactor Technol.* **1**, 51-2(1959) Apr.

A simulation method is given for measuring  $\gamma$  intensity from extended sources of unusual size or shape. A simpler configuration is rotated around an axis of symmetry to generate the required distribution. Self-absorption and multiple scattering can then be investigated by rotating the active element in an appropriate volume distribution of material having purely absorbing or scattering properties in the desired degree. (T.R.H.)

#### 14668

INFLUENCE OF THE SIZE OF AN EXTENDED PLANE SOURCE ON GAMMA-RAY ATTENUATION IN SHIELDING MATERIALS. E. E. Kovalev and P. D. Osanov. *Reactor Technol.* **1**, 52-4(1959) Apr.

A treatment of the effects of source dimension on gamma attenuation is presented. Data are given to illustrate the conclusion that the large dimensions of an extended source influence the estimated gamma attenuation in two ways: the existence of oblique rays increases the calculated attenuation and multiple scattering decreases it more strongly than would be calculated. Thus, corrections can be made for these effects in shielding calculations. (T.R.H.)

#### 14669

ATTENUATION OF THE NEUTRON-CAPTURE  $\gamma$ -RAYS CREATED IN IRON-WATER SHIELDS. V. I. Kukhtevich and S. G. Tsy-pin. *Reactor Technol.* **1**, 54-5(1959) Apr.

The relaxation length of neutron-capture gamma rays in iron-water shields was measured as a function of the proportion of Fe. Neutrons of 4.0 and 14.9 Mev were used. (T.R.H.)

#### 14670

THE ATTENUATION OF NEUTRON FLUXES IN IRON-WATER SYSTEMS. D. L. Broder. *Reactor Technol.* **1**, 55(1959) Apr.

The fast-neutron relaxation length in an iron-water shield was measured versus proportion of iron. (T.R.H.)

#### 14671

THE ABSORPTION OF  $\text{Au}^{198}$ ,  $\text{Co}^{60}$ , AND  $\text{Na}^{24}$   $\gamma$  RAYS IN WATER. V. N. Sakharov. *Reactor Technol.* **1**, 55-7(1959) Apr.

An experimental study of the absorption in water of gamma rays from a point source is described, and a

computation is given which extends the results to give the dose rate from a uniform distribution of gamma source density in water. (T.R.H.)

#### 14672

ON THE MEASUREMENT OF RESONANCE NEUTRON ABSORPTION IN HETEROGENEOUS U-D<sub>2</sub>O SYSTEMS. B. F. Belkin, P. A. Krupchitsky, and Yu. V. Orlov. Reactor Technol. **1**, 57-60(1959) Apr.

This paper was previously abstracted from the original language and appears in NSA, Vol. 12, as abstract No. 9456.

#### 14673

EXCITATION OF THE SPECTRUM IN A SPARK DISCHARGE. S. Mandelstam (Mandel'shtam) (P. N. Lebedev Physical Inst., Academy of Sciences, U.S.S.R., Moscow). Spectrochim. Acta Nos. 3/4, 255-71(1959) May.

A short account of the result of a series of theoretical and experimental investigations carried out in the last few years by a group of investigators in the Physical Institute of the Academy of Sciences of the U.S.S.R. is given. As the result of these investigations a hydrodynamic theory of the spark channel has been developed and a detailed picture of the process of excitation of spectra in the spark channel is obtained. The plasma of the channel in air is completely ionized and consists mainly of doubly charged ions of nitrogen; the density of the gas is approximately  $5 \times 10^{-3}$  that of air under normal conditions and the concentration of electrons is approximately  $10^{17}$  per cm<sup>3</sup>. Ions and electrons are at practically the same temperature 40,000 to 50,000°C; the time required to reach temperature equilibria of ions and electrons is about  $10^{-7}$  sec. The distribution of atoms, ionization and excited states is given by the equations of Saha and Boltzmann, and the time for establishment of this distribution is between  $10^{-7}$  and  $10^{-10}$  sec. (auth)

#### 14674

OSCILLATIONS OF A PLASMA IN A MAGNETIC FIELD AT FREQUENCIES CLOSE TO CYCLOTRON FREQUENCIES. V. N. Lazukin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 969-75(1959) Apr. (In Russian)

Plasma beam oscillations in a longitudinal magnetic field at frequencies which are several times smaller than the ion cyclotron frequencies are described. The method applied permitted the observation of the oscillation spectrum as a set of narrow lines with a very large signal-to-noise ratio. It is suggested that the observed oscillations are analogous to hydromagnetic waves familiar from the theory. (auth)

#### 14675

MAGNETO-OPTICAL RESONANCE IN NICKEL AT INFRARED FREQUENCIES. G. S. Krinchik and R. D. Nuralieva (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1022-4(1959) Apr. (In Russian)

Resonance absorption of infrared light in nickel was detected by a magneto-optical method. The resonance wave length of 4 to 5  $\mu$  corresponds to the reorientation energy of the electron spin magnetic moment in the exchange field of a ferromagnetic. (auth)

#### 14676

ANOMALOUS ELECTRON SCATTERING AND EXCITATION OF PLASMA OSCILLATIONS. M. D. Gabovich and L. L. Pasechnik (Inst. of Physics, Academy of Sciences, Ukraine SSR). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1025-33(1959) Apr. (In Russian)

The interaction between an electron beam and independently formed plasma which leads to a considerable change in the electron energy and to excitation of plasma oscillations was investigated. The observed facts can be qualitatively interpreted by assuming that the electrons gather in clusters and that these clusters coherently interact with the plasma. (auth)

#### 14677

ON SOME NEW DISPERSION RELATIONS IN QUANTUM FIELD THEORY. L. A. Khalfin. Zhur. Eksptl'. i Teoret. Fiz. **36**, 1088-92(1959) Apr. (In Russian)

Some new dispersion relations between the module and phase shift of the forward scattering amplitude were obtained. In contrast to the usual dispersion relations between the real and imaginary parts of the forward scattering amplitudes the present ones are independent of the detailed behavior (degree of increase or decrease) of the forward scattering amplitude at infinitely high energies. In connection with the deduced dispersion equations the problem concerning possible zeroes of the forward scattering amplitude in its region of analyticity is considered. (auth)

#### 14678

THE NEW CLASS OF THE REPRESENTATIONS OF THE TOTAL LORENTZ GROUP. G. A. Sokolik. Zhur. Eksptl'. i Teoret. Fiz. **36**, 1098-1102(1959) Apr. (In Russian)

All representations of the total Lorentz group are found. Those are shown to be reduced to direct products of spinor representations belonging to the three types. An attempt is made to interpret the isotopic spin in terms of the generalized parity operator without introducing any new degrees of freedom. It is proved that the exclusion principle does not hold for the new class of spinors, transforming according commuting operators of space, time, and space-time reflection. (auth)

#### 14679

WALL PROBE IN A MAGNETIC FIELD. I. K. Fetisov. Zhur. Eksptl'. i Teoret. Fiz. **36**, 1110-18(1959) Apr. (In Russian)

The current flowing to a wall probe in a strong magnetic field is computed in the case when the motion of the electrons along the magnetic field can be considered to be free and across the field, diffusional. (auth)

#### 14680

PLASMA EQUATION OF STATE. A. A. Vedenov and A. I. Larkin (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1133-42(1959) Apr. (In Russian)

The free energy  $F$  of a completely ionized gas is derived in the form of an expansion in the density  $F = F_{\text{ideal}} + A n^{5/3} + B n^2 \ln n + C n^2$ . The term  $A n^{5/3}$  is identical with the familiar Debye-Hückel term. Expressions for the functions  $B$  and  $C$  were obtained. The diagram technique was employed in the calculations. (auth)

#### 14681

STABILITY OF A PLANE POISEUILLE FLOW OF AN IDEALLY CONDUCTING FLUID IN A LONGITUDINAL MAGNETIC FIELD. E. P. Velikhov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1192-1202(1959) Apr. (In Russian)

The necessary and sufficient conditions for stability of a flow in a magnetic field were found. It is shown that the critical value of the magnetic field which stabilizes the flow is  $0.1 \times V_0 \sqrt{4\pi\rho}$ , where  $V_0$  is the velocity in the center of the channel and  $\rho$  is the fluid density. (auth)



**14682**

ON THE INFLUENCE OF IMPURITIES ON X-RAY SPECTRA OF TRANSITION METALS. I. B. Borovskii and K. P. Gurov (Inst. of Metallurgy, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1203-6(1959) Apr. (In Russian).

A method is proposed which permits one to estimate the effect of impurities on the parameters of the transition metal x-ray emission spectra. The method is applied to the case of diluted alpha-solid solutions with iron as the base. (auth)

**14683**

ANGULAR DISTRIBUTION AND ANGULAR CORRELATION OF RADIATIONS OF THE NUCLEI WITH ORIENTED ELECTRON SHELLS. V. A. Dzhrbashyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1240-5(1959) Apr. (In Russian)

The effect of an interacting oriented electron shell on the angular correlation of nuclear radiations is investigated. The angular distribution due to this effect is obtained. (auth)

**14684**

THE FUNDAMENTAL COMPENSATION EQUATION IN SUPERCONDUCTIVITY THEORY WITH ACCOUNT OF COULOMB INTERACTION. Chen Chun-sian and Chow Shih-hsun (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1246-53(1959) Apr. (In Russian)

The Fröhlich model which takes into account Coulomb interaction is investigated by the Bogolyubov method. In order to eliminate the infrared divergence of the expansion, partial summation of the perturbation theory series was performed by approximate second quantization. This yields in explicit form the fundamental compensation equation for dangerous diagrams and also the expression the renormalized energy of single-fermion excitation with account of Coulomb interaction. (auth)

**14685**

ON THE THEORY OF WEAK FERROMAGNETISM. E. A. Turov (Inst. of Metal Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1254-8(1959) Apr. (In Russian)

A number of properties of weak ferromagnetics at low temperatures are investigated from the viewpoint of Dzyaloshinsky's theory which considers weak ferromagnetism as a simple consequence of magnetic symmetry of antiferromagnetic crystals of a definite magnetic structure. Cases of "transverse" and "longitudinal" weak ferromagnetism are considered (in the first case the spontaneous magnetic moment is perpendicular and in the second parallel to the antiferromagnetism axis). The spin wave energy, temperature dependence of the magnetization, and the spin part of the thermal capacity were computed. (auth)

**14686**

EFFECT OF SHAPE OF THE SPECIMEN ON FERROMAGNETIC RESONANCE IN A STRONG RADIOFREQUENCY FIELD. G. V. Skrotskii and Yu. I. Alimov (Uran Polytechnic Inst.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1267-71(1959) Apr. (In Russian)

The exact solutions of the Landau-Lifshits equations for nonspherical ferromagnetic specimens in a radio-frequency field of arbitrary amplitude are analyzed. An expression was derived for the threshold field  $h_c$  above which instability in the motion of the magnetization vector begins. The slow decrease of the magnetization component and the shift of the resonance field for field

strengths  $h_0 > h_c$  are explained. It is shown that for  $h_0 > h_c$  the height of the absorption peak decreases and its width increases. (auth)

**14687**

ON THE DISINTEGRATION OF UNSTABLE SHOCK WAVES IN MAGNETOHYDRODYNAMICS. G. Ya. Lyubarskii and R. V. Polovin (Inst. of Physics and Tech., Academy of Sciences, Ukraine SSR). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1272-8(1959) Apr. (In Russian)

The fate of an unstable magnetohydrodynamic shock wave is considered, and it is shown that such a wave must necessarily disintegrate into several waves among which there are fast and slow magnetoacoustic shock and similarity waves, Alfvén discontinuities, and a contact discontinuity. It is significant that disintegration of an unstable shock wave is accompanied by an increase of the entropy. Disintegration of a stable shock wave is impossible. (auth)

**14688**

THE GREEN'S FUNCTION METHOD IN QUANTUM STATISTICS. E. S. Fradkin (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1286-98(1959) Apr. (In Russian)

A Green's function method in quantum statistics is developed. It is shown that the equations obtained contain in a simple approximation various methods encountered in statistical physics and in many-particle theory as well as their extension to cases of nonvanishing temperature (e.g. the Debye-Hückel, Hartree-Fock, Thomas-Fermi, Gell-Mann, and Brueckner methods). A transition to time-dependent Green's functions is considered, and a method for determination of the energy spectrum of the system is proposed. (auth)

**14689**

ON ROTATION OF THE POLARIZATION PLANE OF ELASTIC WAVES IN MAGNETOPOLARIZED MEDIA. K. B. Vlasov and B. Kh. Ishmukhametov (Inst. of Metal Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1301-3(1959) Apr. (In Russian)

The propagation of plane elastic waves in magnetopolarized media (found in constant homogeneous polarizing magnetic field  $H_0$  or having constant uniform polarization magnetization  $I_0$ ) with a single symmetry axis was investigated. (R.V.J.)

**14690**

ATOMIC STRUCTURE FLUCTUATIONS IN HELIUM. V. K. Prokhorenko and I. Z. Fisher (Belorussian State Univ.). Zhur. Eksptl'. i Teoret. Fiz. **36**, 1311-12 (1959) Apr. (In Russian)

Previous works indicated the compact arrangement of liquid helium atoms with a coordinate number of nearly eight units. However, the mean distance between the closest atoms considerably exceeds the distance to the minimum point on the curve of the potential energy for the atomic pair interactions, which are related to the zero oscillations of atoms. Moreover, it was found that the atomic structure at  $\sim 2$  to  $5^\circ\text{K}$  is not sensitive to variations in temperature and does not change in transition through the  $\lambda$  point. In view of the structural specificity of liquid helium, studies were made of the mean atomic structure and fluctuations of this structure. (R.V.J.)

**14691**

PERMANENT STRUCTURE OF SHOCK WAVES WITH JOULE DISSIPATION. V. A. Belokon (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur.

*Eksptl'. i Teoret. Fiz.* **36**, 1316-17(1959) Apr. (In Russian)

The Raman and isentropic break of parameters of flow inside a wave of arbitrary amplitude is postulated as analogous to an isothermal discontinuity in a pure heat-conducting gas. (R.V.J.)

#### 14692

ON THE EXPANSION OF SPECTRAL LINES IN STRONGLY IONIZED PLASMA. M. A. Mazing and S. L. Mandel'shtam (Lebedev Inst. of Physics, Academy of Sciences, USSR). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1329-31(1959) Apr. (In Russian)

The width and shift of Ar II lines and several He I lines in spark discharge plasma were studied ( $V = 14$  kv,  $C = 0.02 \mu F$ ,  $L = 10 \mu H$ ) at temperatures of 30,000 to 40,000° K and electron concentration  $\sim 10^{17} \text{ cm}^{-3}$ . (R.V.J.)

#### 14693

ON ELECTRON PLASMA OSCILLATIONS. A. A. Zaitsev, G. S. Leonov, and I. A. Savchenko (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1332-4(1959) Apr. (In Russian)

Inert gases with alternating pressure from  $3 \times 10^{-1}$  to  $5 \times 10^{-4}$  mm were studied by means of a heterogeneous system with a separate decimeter range generator and an intermittent frequency amplifier with the frequency and penetrating band of 30 and 10 MHz. It was found that the upper pressure at which oscillations were not observed differed greatly for different gases. For He the limiting pressure was  $2 \times 10^{-1}$ , for Ar near  $10^{-2}$ , and for Xe about  $6 \times 10^{-3}$  mm. Moreover, the total effective atomic cross section for interactions with primary electrons for the above gases and pressures, considering the electron beam velocity rate, did not differ more than 25%. Attempts were made to analyze the oscillations along the discharge axis without the influence of a probe. The oscillation intensities and amplification coefficient increase with reduced pressure. Anomalous primary beam scattering was observed in the strong oscillation region. During the scattering before the pinch small separate beams were observed in the primary beam background while the scattering after the pinch showed a uniform beam. In the first event the beam convergence was curtailed at the scattering point without forming a knot, while in the latter case no tendencies of forming subsequent knots were observed. (R.V.J.)

#### 14694

THE APPLICATION OF A FLOW COUNTER FOR MEASURING THE MOISTURE PERMEABILITY OF FILMS FROM SYNTHETIC MATERIALS WITH THE AID OF TRITIUM LABELLED WATER. E. E. Finkel and K. V. Chmutov (Inst. of Physical Chemistry, Moscow). *Zhur. Fiz. Khim.* **33**, 943-7(1959) Apr. (In Russian)

The moisture permeability of synthetic materials was measured with the aid of tritium-labeled water and using a flow counter of the type SVS-6. It was found that the most convenient carrier gas for measuring the activity of water vapors labelled with tritium were ethyl alcohol vapors. Their flow through the counter is maintained at a set level by vaporization from the liquid phase at one side of the counter and by continuous evacuation on the other. A special vacuum arrangement was designed for this method permitting the simultaneous testing of 3 specimens under different temperature conditions. By using the flow counter the limits of measurement can be very

easily changed by changing the magnitude of flow of the carrier gas. Facilitation of the measurements by employing the flow counter in comparison with the internal filling counter shortened the duration of tests from several days to a few hours. (auth)

#### 14695

THE STRUCTURE AND PROPERTIES OF POROUS MATERIALS. Proceedings of the Tenth Symposium of the Colston Research Society held in the University of Bristol, March 24-March 27th, 1958. D. H. Everett and F. S. Stone, eds. New York, Academic Press Inc., 1958. 401p.

Sixteen papers are presented on such subjects as (1) aspects of sorption in porous crystals, (2) surface characteristics of carbons, (3) energetics of sorption, (4) relation between gas permeability and pore structure of solids, (5) preparation and adsorptive properties of silica gels, (6) the porous structure of paper, (7) structure of porous building stone, etc. (A.C.)

## Elementary Particles

#### 14696 AD-157621

Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. A STUDY OF THE TRANSMISSION OF Po-Be NEUTRONS IN IRON WITH EMPHASIS ON THE CHARACTERISTICS OF THE HURST DETECTOR UNDER GAS FLOW CONDITIONS (thesis). John Charles Balogh. Mar. 1958. 64p.

The use of the Hurst detector as a flow counter is discussed. Particular emphasis is given to its sharp sensitivity to applied voltage and temperature variations. It is noted that the variations observed may be due to the introduction of liquid hydrocarbons into the detector. The liquid hydrocarbons were probably formed by polymerization of the ethylene gas used in the detector. A theoretical interpretation of sphere transmissions was developed from single scattering considerations. By appropriate selection of the average energy of an inelastically scattered neutron, an excellent correspondence is established between measured and theoretical results for an 11.9 cm spherical shell of iron. A theoretical derivation of the effect of reflected neutrons from the paraffin shield upon dose measurements is discussed. Three limiting cases of penetration by a neutron, along the normal to the paraffin wall from the source, to thicknesses of one, fifteen, and thirty centimeters were solved. The results indicate that the reflection induces no significant error into the results. (auth)

#### 14697 AFCRC-TR-58-241

Air Force Cambridge Research Center, Bedford, Mass. OBSERVATIONS ON HEAVY PRIMARY COSMIC RAY NUCLEI ABOVE THE ATMOSPHERE. Geophysical Research Papers No. 60. Herman Yagoda. May 22, 1958. 42p. (AD-152585; PB-151230). \$1.25(OTS).

The flux of heavy primaries of  $Z \geq 6$  was evaluated from small emulsion blocks flown on Aerobee rockets especially designed to keep condensed matter below  $0.2 \text{ g cm}^{-2}$  after penetrating the atmosphere. Parachute recoveries were effected from a day and a night flight, yielding  $J_S^0 = 4.85 \pm 0.95$  and  $5.05 \pm 0.88 \text{ (m}^2 \text{ sec sterad)}^{-1}$ , respectively, suggesting absence of a pronounced day-night effect in the total heavy primary flux. The average for the two Aerobee flights is  $J_S^0 = 4.98 \pm 0.65$  and the  $M^0/H^0$  ratio is  $1.91 \pm 0.55$ , in good agreement with a Viking rocket flight made in 1954 for which



$J_S^0 = 5.38 \pm 0.58$  and  $M^0/H^0 = 2.01 \pm 0.50$  when the omnidirectional fluxes are averaged over the entire zenith angle spread accepted by the emulsions along the rocket trajectories. Balloon observations from the same geomagnetic locality (41°N) yield a vertical flux about 1.61 times greater than the rocket observations, agreeing well with geomagnetic theory which predicts small fluxes at zenith angles greater than 45°. Based on interactions of L and S nuclei and their mean free paths in emulsion, the  $L^0/M^0$  ratio is estimated to be  $0.26 \pm 0.09$  which favors a smaller flux of Li-Be-B nuclei at the top of the atmosphere than in most extrapolations of balloon observations. A study of the mode of fragmentation of the heavy primaries suggests that secondary L nuclei are produced more frequently at rocket elevations than in balloon exposures. This altitude variation may be associated with the anomalous cascades seen on the Viking 10 flights in which secondary L nuclei, originating in the fragmentation of primary S nuclei, appear to have collision cross sections greater than geometric. To confirm this, it is proposed that a 12-lb emulsion block be exposed in an Aerobee-Hi. (auth)

**14698** AFCRC-TR-58-252

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

INVESTIGATION OF SOLAR GAMMA RAY. Final Report. G. M. Burgwald and C. A. Stone. June 23, 1958. 46p. ARF Project No. A-064. Contract AF19(604)-1499. (AD-152630).

In order to determine whether proton induced nuclear reactions take place on the surface of the sun, an experiment has been performed to establish the existence of a capture gamma ray produced in one of the interactions. In the capture of neutrons by hydrogen, deuterium and a 2.23 Mev gamma ray are formed and it is the detection of this specific gamma ray in the earth's upper atmosphere that is being used in an attempt to determine the presence of the reaction. Lack of astronomical information has placed an upper limit of  $1 \times 10^{-4}$  on the deuterium to hydrogen ratio in the solar atmosphere. In a measurement made at 92,000 feet during normal solar conditions, the cosmic ray spectrum shows no increase in intensity at 2.23 Mev. Additional balloon flights are planned and will be made during more active solar conditions. (auth)

**14699** UCRL-8715

California, Univ., Berkeley. Lawrence Radiation Lab. THE PRODUCTION OF NEUTRAL HYPERONS BY 5-BEV  $\pi^-$  MESONS (thesis). David Franklin Hotz. Apr. 13, 1959. 51p. Contract W-7405-eng-48. \$1.50 (OTS).

Neutral hyperons produced by 5-Bev  $\pi^-$  mesons incident on a large propane bubble chamber are analyzed in detail with respect to production cross sections and angular distributions of production and decay, and the  $\Lambda$  lifetime is measured. The cross section for neutral-hyperon ( $\bar{Y}^0$ ) production by the reaction  $\pi^- + p \rightarrow Y^0 + K$  is  $0.98 \pm 0.16$  mb. The cross section for carbon  $\sigma(\pi^- + C \rightarrow Y^0 + K)$  is  $6.05 \pm 0.89$  mb. The mean  $\Lambda$  decay time is  $(3.12 \pm 0.34) \times 10^{-10}$  sec. The corrected lifetime is observed to be  $(3.23 \pm 0.36) \times 10^{-10}$  sec. Although the up-down decay asymmetry for  $\Lambda$  hyperons is not significantly different from zero, the fore-aft decay angular distribution is asymmetric;  $\alpha \bar{P} = -0.31 \pm 0.12$  where the decay proton distribution along the  $\Lambda$  direction of motion has been examined. This is suggested as evidence for nonconservation of parity in the production

interaction. The  $\Lambda$ -production angular distribution is peaked backward in the production center of mass. The  $\Lambda$  momentum spectrum and the distribution of  $\Lambda$ -production star prongs are presented. Sources of bias and their correction are discussed, and an estimate is made of the carbon contamination of the events that contribute to the hydrogen cross section for  $Y^0$  production. (auth)

**14700**

TOTAL CROSS SECTIONS FOR NEUTRONS OF 2.1 TO 3.1 Mev. G. Deconninck and A. Martegani (Université, Louvain, Belgium). *Bull. classe sci., Acad. roy. Belg.* 44, 851-62(1958). (In French)

The total cross sections of Pb, Bi, and Cu were measured between 2.1 and 3.1 Mev, and the  $\sigma_{\text{tot}}$  curve was established as a function of the energy with precision by the application of the diffusion correction. Two resonances were discovered in Mg at 2.35 and 2.65 Mev. Measurements made on Ca show the existence of resonances in this region. (tr-auth)

**14701**

DIFFERENTIAL EQUATIONS OF MESON CHARGE MOTION. I. S. Arzhanykh (Romanovskii Inst. of Mathematics, Academy of Sciences, Uzbek SSR). *Doklady Akad. Nauk S.S.S.R.* 125, 1215-18(1959) Apr. 21. (In Russian)

**14702**

ON PROPERTIES OF K MESONS. Ya. I. Granovskii. *Doklady Akad. Nauk S.S.S.R.* 125, 1225-6(1959) Apr. 21. (In Russian)

The mass, spin, and parity of K mesons were studied on the basis of the Heisenberg theory. (R.V.J.)

**14703**

A METHOD OF ALLOWANCE FOR CORRELATION IN A SYSTEM OF MANY PARTICLES. Ch'eng Ch'ung-hsien (Lomonosov Moscow State Univ.). *Doklady Akad. Nauk S.S.S.R.* 125, 1238-41(1959) Apr. 21. (In Russian)

A general correlation scheme is suggested in order to derive the chain of integral equations in Green's functions for a many-particle system. (R.V.J.)

**14704**

NEUTRON TRANSMISSION PROBABILITY THROUGH A CURVED REVOLVING SLIT. M. Marseguerra and G. Pauli (Comitato Nazionale per le Ricerche Nucleari, Rome). *Nuclear Instr. & Methods* 4, 140-50(1959) Apr.

The formulas of a neutron burst transmitted by a revolving curved slit are analytically derived and are then applied to determine the distribution of the neutrons of the burst, after they have travelled a given distance. (auth)

**14705**

A DEVELOPMENT OF THE GIBBS POTENTIAL OF A QUANTUM SYSTEM COMPOSED OF A LARGE NUMBER OF PARTICLES. III. THE CONTRIBUTION OF BINARY COLLISIONS. Claude Bloch and Cyrano de Dominicis (Centre d'Études Nucléaires, Saclay, France). *Nuclear Phys.* 10, 509-26(1959) Apr. (2). (In French)

Starting from an expansion derived in a previous work, the contribution to the Gibbs potential of the two-body dynamical correlations, taking into account the statistical correlations, is studied. Such a contribution is of interest for low density systems at low temperature. In the zero density limit, it reduces to the Beth-Uhlenbeck expression for the second virial coefficient. For a system of fermions in the zero temperature

limit, it yields the contribution of the Brueckner reaction matrix to the ground state energy, plus, under certain conditions, additional terms of the form  $\exp(8|\Delta|)$ , where the  $\Delta$  are the binding energies of "bound states" of the type first discussed by L. Cooper. Finally, the wave function of two particles immersed in a medium (defined by its temperature and chemical potential) is studied. It satisfies an equation generalizing the Bethe-Goldstone equation for an arbitrary temperature. (auth)

**14706**

ABSORPTION OF POLARIZED  $\mu^-$ -MESONS BY NUCLEI. THE NEUTRON ANGULAR DISTRIBUTION. E. I. Dolinskii (Dolinsky) and L. D. Blokhintsev (Moscow State Univ.). Nuclear Phys. **10**, 527-40(1959) Apr. (2).

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, as abstract No. 4978.

**14707**

THE CAPTURE OF MUONS BY COMPLEX NUCLEI. H. A. Tolhoek (CERN, Geneva). Nuclear Phys. **10**, 606-19(1959) Apr. (2).

A comparison is made of different theoretical approaches for calculating the total rates for capture of muons by complex nuclei. The merits of the closure approximation and shell model calculations are discussed. The application of the closure approximation to a statistical model of the nucleus is worked out in some detail. A tentative explanation of the experimental data in terms of a universal Fermi interaction is given. (auth)

**14708**

EFFECT OF IMPURITIES ON ANGULAR CORRELATION OF POSITRON ANNIHILATION RADIATION. R. L. deZafra (Univ. of Maryland, College Park). Phys. Rev. **113**, 1547-55(1959) Mar. 15.

Angular distribution measurements on two-quantum annihilation radiation from positrons stopping in liquid targets were as a function of concentration of certain impurities in the target materials. The impurities tested were  $Mn^{++}$  and  $Co^{++}$  ions (dissolved from their chloride salts) and  $NO_2^-$  and  $NO_3^-$  ions (dissolved from their sodium salts) in water, and chloroform and the free radical diphenyl-picryl-hydrazyl in benzene. The paramagnetic ions are found to produce a strong enhancement of the narrow-distribution component, ascribed to exchange conversion between triplet and singlet positronium. Conversion cross sections of a few times  $10^{-19}$  cm<sup>2</sup> are obtained assuming a positronium velocity about 5 times thermal velocity at conversion. These are in fair agreement with recent determinations made from lifetime studies. The nitrate and nitrite ions may cause a further broadening of the broad component, which appears to be associated with the chemical binding of positrons to the ions. It is also found that positrons are chemically bound to the chloroform molecule. Some evidence is presented to show that the free radical (diphenyl-picryl-hydrazyl) may not, as previously supposed, act to convert triplet to singlet positronium, but may in fact give rise to chemical binding of positronium to the free radical. (auth)

**14709**

PHASE-SHIFT ANALYSIS OF PROTON-PROTON SCATTERING EXPERIMENTS BELOW 40 Mev. Malcolm H. MacGregor (Univ. of California, Livermore). Phys. Rev. **113**, 1559-74(1959) Mar. 15.

A phase-shift analysis was made of p-p angular distribution measurements at 1.855, 4.203, 9.68, 9.73, 18.2, 19.8, 31.8, and 39.4 Mev. At 1.855 Mev, Coulomb effects plus the nuclear S-wave phase shift are sufficient to give agreement within experimental errors. At 10 Mev, S-, P-, and D-wave effects are apparent. At 40 Mev, F-wave components are also necessary. With the aid of the Clementel-Villi parametrization method, it was possible to determine all of the least-squares fits to the angular distribution data in the S, P, D approximation. Polarization measurements and potential model calculations can be used to further restrict the allowable phase-shift sets. It is shown that angular distribution measurements with an accuracy of 0.1% would not lead to a unique set of phase shifts. Both double- and triple-scattering experiments are necessary in order to remove the ambiguity. (auth)

**14710**

SCATTERING OF POLARIZED ELECTRONS BY POLARIZED NUCLEONS. James H. Scofield (Indiana Univ., Bloomington). Phys. Rev. **113**, 1599-1600(1959) Mar. 15.

The differential cross section for the scattering of arbitrarily polarized charged spin one-half particles by arbitrarily polarized charged spin one-half particles with an anomalous magnetic moment was calculated, including recoil effects. (auth)

**14711**

EVIDENCE FOR THE TRANSITION OF A  $K^0$  INTO A  $\bar{K}^0$  MESON. Frank S. Crawford, Jr., Marcello Cresti, Myron L. Good, Klaus Gottstein, Ernest M. Lyman, Frank T. Solmitz, M. Lynn Stevenson, and Harold Ticho (Univ. of California, Berkeley). Phys. Rev. **113**, 1601-4(1959) Mar. 15.

Two pictures were obtained in a liquid-hydrogen bubble chamber, each of which demonstrates the following sequence: (1)  $\pi^- + p \rightarrow Y^0 + K^0$ , [ $Y_A^0 = \Lambda^0$ ,  $Y_B^0 = \Sigma^0$ ], (2)  $\Lambda \rightarrow p + \pi^-$ , (3)  $K^0 \rightarrow (\sim 50\%) \bar{K}^0 + (\sim 50\%) K^0$ , (4)  $\bar{K}^0 + p \rightarrow \Sigma^+ + \pi^0$ , (5)  $\Sigma^+ \rightarrow n + \pi^+$ , where step (3) is not directly observable, but is a prediction of the theory of Gell-Mann and Pais. On the basis of two events, the cross section for process (4) is 30 mb. (auth)

**14712**

DECAY OF  $\Lambda H^3$  AND THE SPIN DEPENDENCE OF THE  $\Lambda$ -NUCLEON INTERACTION. M. Leon (Cornell Univ., Ithaca, N. Y.). Phys. Rev. **113**, 1604-7(1959) Mar. 15.

A calculation is made of the fraction of the  $\pi$ -mesonic decays of the hypertriton  $\Lambda H^3$  which yield the two final products  $He^3$  and  $\pi^-$ . This fraction is a function of the spin of  $\Lambda H^3$  and of the ratio p/s of the amplitudes for decay of the free  $\Lambda$  via the s- and p-wave channels. The results are compatible with the present experimental data. They indicate that probably p/s  $\leq 1$ , and that the spin of  $\Lambda H^3$  is  $1/2$ , which implies that the singlet  $\Lambda$ -nucleon interaction is more attractive than the triplet. These results are in agreement with those of a previous calculation by Dalitz for  $\Lambda H^4$ . (auth)

**14713**

DIRECT-INTERACTION MODEL CALCULATION OF HIGH-ENERGY PROTON-CARBON SCATTERING. Alan H. Cromer (Cornell Univ., Ithaca, N. Y.). Phys. Rev. **113**, 1607-14(1959) Mar. 15.

An optical potential was derived which includes, to first order in  $q^2$ , the effect of the nucleon-nucleon angular dependence. Nucleon-nucleon scattered amplitudes calculated from the 310-Mev nucleon-nucleon phase shifts were put into the potential and the proton-carbon



scattered amplitudes calculated from it by WKB approximation. Good agreement was obtained with the scattered amplitudes as derived directly from the 313-Mev proton-carbon data using an extension of the analysis employed previously by Bethe. The inclusion of the nucleon-nucleon angular dependence in the potential was found to be important in order to obtain the correct value of the imaginary part of the forward scattered amplitude and the correct proton-carbon angular dependence at moderately small angles. Phase shift solutions 1 and 6 of Stapp et al. were investigated and found to give essentially the same agreement with the differential cross section at small angles. Solution 6 was found to give a better fit to the polarization data than solution 1, but the significance of this is not clear. (auth)

#### 14714

##### ANTIPROTON-NUCLEON ANNIHILATION PROCESS.

II. Owen Chamberlain, Gerson Goldhaber, Louis Jauneau, Theodore Kalogeropoulos, Emilio Segrè, and Rein Silberberg (Univ. of California, Berkeley). Phys. Rev. **113**, 1615-34(1959) Mar. 15.

Work was continued on antiproton interactions in photographic emulsions. Most of the data come from an exposure at the Bevatron to an enriched antiproton beam of 700 Mev/c momentum. An analysis of 221 antiproton stars is presented, 95 of which occurred in flight. An average antiproton cross section of  $(1.9 \pm 0.2)\sigma_0$ , where  $\sigma_0 = \pi(1.2 \times 10^{-13} \text{A}^{1/2})^2 \text{ cm}^2$ , for all the elements in emulsion was found, excluding hydrogen. The primary antiproton annihilation gives rise to  $5.36 \pm 0.3$  pions on the average. In annihilations at rest, 1.3 of the pions formed interact with the parent nucleus; in reactions in flight, 1.9 of the pions. For stars at rest the energy available in the annihilation in complex nuclei is divided up among the products as follows: charged pions,  $48 \pm 6\%$ , neutral particles (other than neutrons and  $K^0$  mesons)  $28 \pm 7\%$ ; K mesons  $3 \pm 1.5\%$ ; and cascade nucleons and nuclear excitation  $21 \pm 2\%$ . For the stars in flight the corresponding percentages are:  $45 \pm 7$ ,  $22 \pm 7$ ,  $3 \pm 1.5$ , and  $30 \pm 2\%$ . To fit the average pion multiplicity, the interaction radius of the Fermi statistical model must be taken as  $2.5\hbar/m_\pi c$ . Other proposals to explain the large multiplicity are discussed. From the fraction of pions interacting in the same nucleus, it is deduced that the annihilation takes place at the outer fringes of the nucleus. (auth)

#### 14715

HEAVY-MESON-HYPERON RELATIVE PARITY AND THE SIGN OF THE COULOMB INTERFERENCE IN  $K^-p$  SCATTERING. E. Galzenati and B. Vitale (Università, Naples, and C.N.R.N., Naples). Phys. Rev. **113**, 1635-40(1959) Mar. 15.

Two subtracted dispersion relations are applied at the same time to the study of the dependence of the real part of the  $K^-p$  scattering amplitude at zero energy,  $D_-(K)$ , on the values of the coupling constants  $gy^2$ . The results, when compared with the existing experimental information, strongly indicate that the K meson is  $ps$ -ps (namely pseudoscalar with respect to both the  $\Lambda$  and the  $\Sigma$  hyperon) and that the sign of  $D_-(\omega)$  at low energy is positive, giving constructive Coulomb interference in the  $K^-p$  elastic scattering. (auth)

#### 14716

RADIATIVE CORRECTIONS TO FERMI INTERACTIONS. Toichiro Kinoshita (Cornell Univ., Ithaca, N. Y.) and Alberto Sirlin (Columbia Univ., New York). Phys. Rev. **113**, 1652-60(1959) Mar. 15.

The radiative correction to the decay spectrum of polarized muons is recalculated taking into account a mistake in previous work which was recently pointed out by Berman. The revised values for the radiative correction to  $\delta$ ,  $\xi$ , and integrated asymmetries for the high- as well as low-energy decay electrons have turned out to be practically identical with the old values. The  $\rho$  value determined from experiments, on the other hand, has to be increased by about 1% because of the new correction. Thus the over-all effect of the radiative correction to the  $\rho$  value is now an increase of the order of 5.6% when the experimental and theoretical spectral distributions are compared in the region  $0 \leq p/p_{\max} \leq 0.95$ . The radiative corrections to the spectrum and lifetime of the nuclear  $\beta$  decay arising from the charge interactions of the electron and proton are also studied. Use of this expression gives a correction of  $-1.7\%$  for the lifetime of  $O^{14}$ . The corrected Feynman-Gell-Mann coupling constant is  $G = (1.40 \pm 0.01) \times 10^{-49} \text{ erg/cm}^3$ . In the universal V-A theory of weak interactions, the calculated muon mean life becomes  $\tau_\mu = (2.31 \pm 0.05) \times 10^{-6} \text{ sec}$ . (These three values depend logarithmically on the ultraviolet cutoff  $\lambda$  and the corrections to  $\tau_\mu$  increase for increasing values of  $\lambda$ .) It is found that the corrections to the spectral shape of  $\beta$  decay are rather large in the case in which the end-point energy  $E_m \gg m_e c^2$ . The radiative corrections to the lifetime and the total asymmetry for muon decay are found to be well defined and finite for  $m_e \rightarrow 0$  in spite of the fact that the differential spectrum itself diverges logarithmically in the same limit. The same situation is encountered in the case of radiative corrections to the nuclear  $\beta$  decay. A physical explanation for such behavior of the radiative corrections is attempted. In Appendix A, a simplified expression is given for the determination of the Michel parameter. (auth)

#### 14717

REPRESENTATIONS OF THE DIRAC EQUATION. S. K. Bose, A. Gamba, and E. C. G. Sudarshan (Univ. of Rochester, N. Y.). Phys. Rev. **113**, 1661-3(1959) Mar. 15.

A representation of the Dirac equation which displays its extreme relativistic properties is discussed. The "spin" appears naturally related to the "position." (auth)

#### 14718

##### SYMMETRY LAWS AND STRONG INTERACTIONS.

J. J. Sakurai (Univ. of California, Berkeley). Phys. Rev. **113**, 1679-92(1959) Mar. 15.

An attempt is made to explore the possible connection between symmetry laws in internal space (e.g., isospin space) and symmetry laws in Lorentz space with special attention to the question: Why are the strong interactions parity-conserving? For direct (nonderivative-type) pion-nucleon interactions, CP invariance and charge independence are sufficient to guarantee the separate conservation of P and C, as previously pointed out. For derivative-type pion-nucleon interactions, charge independence and G invariance (rotational and inversion invariance in three-dimensional isospin space) require that parity (and CP) be conserved; in addition we can also show that the charge-triplet pion must be pseudoscalar, provided that the virtual Yukawa process  $\pi^0 \rightleftharpoons p + \bar{p}$  is allowed or, equivalently, the  $\pi^0$  can be regarded as a bound state of a proton and an antiproton as far as symmetry laws are concerned. For the K couplings, analogous conditions cannot be obtained from the

usual assumption of charge independence alone. However, if the K couplings (rather than the  $\pi$  couplings) exhibit a higher internal symmetry in the sense that the K couplings are universal, the high K symmetry plus charge independence in the usual sense imply parity conservation both in the case of CP-invariant nonderivative-type K interactions and in the case of G-invariant derivative-type K interactions. The high K symmetry also implies that the relative  $N\Xi$  parity as well as the relative  $\Lambda\Sigma$  parity is even. It is conjectured that, if the K couplings must be of a derivative type, only ps-pv coupling is allowed, which means that the K particle is pseudoscalar. The global symmetry model which cannot be reconciled with our assumption of the high K symmetry is re-examined. The high K symmetry is destroyed in a specific and definite manner by the  $\pi$  couplings, and relations among the various coupling constants are inferred from the baryon mass spectrum. Some empirical implications of our model are discussed. Whereas G invariance requires the symmetric appearance of the two chiral spinors  $\frac{1}{2}(1 + \gamma_5)\psi$  and  $\frac{1}{2}(1 - \gamma_5)\psi$  for strangeness-conserving processes, for strangeness-nonconserving processes G conjugation carries charge-conserving interactions into inadmissible interactions that do not conserve electric charge. Hence, if the point of view is taken that parity-conserving interactions are generated by G conjugation, we have some understanding of the puzzling fact that strangeness conservation and parity conservation have the same domain of validity. Further theoretical speculations are made. (auth)

#### 14719

INDICATION FOR K,  $\Lambda$ ,  $\Sigma$  RELATIVE PARITIES FROM EFFECTIVE-RANGE ANALYSIS OF  $K^+$ -p SCATTERING. D. Amati (Universita, Rome, and Istituto Nazionale di Fisica Nucleare, Rome). *Phys. Rev.* **113**, 1692-5(1959) Mar. 15.

From dispersion relations an effective range formula is derived for  $K^+$ p scattering. In the expression for the effective range, the integrals over the cross sections are certainly convergent and weighted against the contributions from the unphysical region. This expression is then analyzed under the experimentally suggested hypothesis of rather constant  $K^+$ p cross sections up to  $\sim 110$  Mev; it is observed that the effective range is rather energy independent and the integrals contributing to it are estimated to be all of the same sign. The expression for the effective range is then quantitatively evaluated, and it is shown that the comparison with the low-energy dependence of  $\sigma^+$  indicates equal  $\Lambda$  and  $\Sigma$  parities with opposite K parity (K pseudoscalar). The possibility of evaluating the coupling constants from the low-energy behavior of the  $K^+$ p cross section is then briefly discussed. (auth)

#### 14720

SEARCH FOR THE DECAY  $\mu^+ \rightarrow e^+ + \gamma$ . H. F. Davis, A. Roberts, and T. F. Zipf (Univ. of Rochester, N. Y.). *Phys. Rev. Letters* **2**, 211-13(1959) Mar. 1.

The branching ratio p in the  $\mu^+ \rightarrow e^+ + \gamma$  reaction, when calculated by assuming an intermediate meson coupling, is of the order  $10^{-4}$ . Results are reported from an experiment in progress designed to obtain a more precise value of p. A 32-Mev  $\pi^+$ -meson beam is stopped in a carbon target. The  $\mu^+$  mesons also stop and decay in the target. Counter telescopes register coincident positrons and gammas emitted in opposite directions from the target. (W.D.M.)

#### 14721

PRECISE DETERMINATION OF THE MUON MAGNETIC MOMENT. R. L. Garwin, D. P. Hutchinson, S. Penman, and G. Shapiro (Columbia Univ., New York). *Phys. Rev. Letters* **2**, 213-15(1959) Mar. 1.

A stroboscopic method was adopted for determining the muon magnetic moment, in which the muon is brought to rest with its spin perpendicular to a magnetic field. By use of a high precession frequency and by a different method of utilizing time information of the muon decay, the experiment described achieved a muon moment accuracy of 0.007%. (W.D.M.)

#### 14722

NEUTRAL CASCADE HYPERON EVENT. Luis W. Alvarez, Philippe Eberhard, Myron L. Good, William Graziano, Harold K. Ticho, and Stanley G. Wojcicki (Univ. of California, Berkeley). *Phys. Rev. Letters* **2**, 215-19(1959) Mar. 1.

In an attempt to establish the existence of a neutral cascade hyperon  $\Xi^0$ , the 15-inch hydrogen bubble chamber was operated in a separated beam of  $1.15 \pm 0.02$ -Bev/c  $K^-$  mesons produced by the Bevatron. Of seven double  $V^0$  events one was interpreted as a  $\Xi^0$  cascade. A photograph and diagrams are presented. (W.D.M.)

#### 14723

SEARCH FOR ENHANCEMENT OF BREMSSTRAHLUNG PRODUCED BY 575-Mev ELECTRONS IN A SINGLE CRYSTAL OF SILICON. W. K. H. Panofsky and A. N. Saxena (Stanford Univ., Calif.). *Phys. Rev. Letters* **2**, 219-20(1959) Mar. 1.

A single-crystal of silicon of 0.013-in. thickness was placed in the analyzed beam of the Stanford electron linear accelerator. The crystal was mounted in a double goniometer. X rays radiated in the crystal were detected by photoproduction of pions in a polyethylene target. The pion counting rate was examined as a function of "scanning" the goniometer over a range of  $\pm 0.04$  radian about both axes in steps of 0.010 radian. No statistically significant dependence of x-ray intensity on crystal orientation was found. (W.D.M.)

#### 14724

NUCLEON-NUCLEON SPIN-ORBIT INTERACTION POTENTIAL. M. H. Hull, Jr., K. D. Pyatt, Jr., C. R. Fischer, and G. Breit (Yale Univ., New Haven). *Phys. Rev. Letters* **2**, 264-6(1959) Mar. 15.

A recent publication reports the effect of a change in the spin-orbit interaction and compares the results with the phenomenologic fits of Stapp et al. Additional calculations at Yale confirm the view that the representation of data by the potential is in many respects not altogether satisfactory and indicate that the new fits to 310-Mev data do not appear reasonable in the light of the phase shift energy dependence between 150 and 310 Mev and of disagreement with experiment in several cases between 142 and 345 Mev. Results of the investigation are graphically shown. (A.C.)

#### 14725

EVIDENCE FOR THE  $\Delta I = \frac{1}{2}$  RULE. Frank S. Crawford, Jr., Marcello Cresti, Roger L. Douglass, Myron L. Good, George R. Kalbfleisch, M. Lynn Stevenson, and Harold K. Ticho (Univ. of California, Berkeley). *Phys. Rev. Letters* **2**, 266-9(1959) Mar. 15.

The  $\Delta I = \frac{1}{2}$  rule predicts the value  $R_{\Lambda} \equiv P(\Lambda \rightarrow \pi^-)$  (all  $\Lambda$ ) =  $\frac{2}{3}$ . Preliminary values were in good agreement with the above prediction. An analysis of 1091 events is now complete and is reported. The data show



no contradictions with the predictions of the  $\Delta I = \frac{1}{2}$  rule. (A.C.)

#### 14726

CHARGE INDEPENDENCE IN THE REACTIONS  $p + d \rightarrow \pi^0 + \text{He}^3$  AND  $p + d \rightarrow \pi^+ + \text{H}^3$  AT 450 Mev. A. V. Crewe, E. Garwin, B. Ledley, E. Lillethun, R. March, and S. Marcowitz (Univ. of Chicago). Phys. Rev. Letters **2**, 269-70(1959) Mar. 15.

According to the principle of charge independence, the ratios of the cross sections for the two reactions  $p + d \rightarrow \pi^+ + \text{H}^3$  and  $p + d \rightarrow \pi^0 + \text{He}^3$  should be exactly a factor of two. The differential cross sections for these two reactions were measured by counting only heavy particles. The differential cross section of the two processes at the angles measured is graphically shown. A weighted mean for the branching ratio  $\sigma_{\text{H}^3}/\sigma_{\text{He}^3}$  was computed from these data to be  $1.91 \pm 0.25$ . There is no evidence to show that the principle of charge independence does not hold. (A.C.)

#### 14727

p-p TRIPLE SCATTERING AT 143 Mev. C. F. Hwang, T. R. Ophel, E. H. Thorndike, Richard Wilson, and N. F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters **2**, 310-12(1959) Apr. 1.

The depolarization parameter D for proton-proton scattering at 147 Mev was measured using a polarized proton beam. The values of D obtained and those of Taylor and Wood are graphically shown. D was also measured at 635 Mev by Kumekin et al. The angular dependence of their results is in agreement with the Harvard results. (A.C.)

#### 14728

K<sup>-</sup>-HYDROGEN CHARGE-EXCHANGE SCATTERING. Philippe Eberhard, Arthur H. Rosenfeld, Frank T. Solmitz, Robert D. Tripp, and Mason B. Watson (Univ. of California, Berkeley). Phys. Rev. Letters **2**, 312-13 (1959) Apr. 1.

During a bubble chamber investigation of the interaction of low-energy K<sup>-</sup> mesons in hydrogen, forty-five reactions of the type  $K^- + p \rightarrow \bar{K}^0 + n$  were observed followed by the decay  $K_L \rightarrow \pi^+ + \pi^-$ . The calculated momentum of the K<sup>-</sup> at the point of interaction depends on the  $\bar{K}^0$ -K<sup>-</sup> mass excess which was found to be  $3.9 \pm 0.6$  Mev. Data were taken with the beam momentum adjusted for  $310 \pm 22$  and  $410 \pm 15$  Mev/c. The fraction of K<sup>0</sup> decaying by the  $\pi^+ + \pi^-$  mode was taken to be  $0.34 \pm 0.02$ . The K<sub>L</sub><sup>0</sup> mean life obtained was  $(0.87 \pm 0.13) \times 10^{-10}$  sec, in agreement with other experiments. (A.C.)

#### 14729

NUCLEAR INTERACTION OF A PROTON OF ABOUT  $10^{15}$  ev PRODUCING AN ELECTRON-PHOTON CASCADE OF  $2.4 \times 10^{13}$  ev. M. W. Teucher, E. Lohrmann, D. M. Haskin, and Marcel Schein (Univ. of Chicago). Phys. Rev. Letters **2**, 313-15(1959) Apr. 1.

A nuclear interaction initiated by a proton of type 6 + 16<sub>p</sub> was found in a nuclear emulsion flown above 110,000 feet. The angular distribution of the shower particles indicates that the primary energy was between  $10^{14}$  and  $10^{15}$  ev. An unusually energetic electron-photon cascade was initiated which could be followed by 22.6 cm. This cascade appears to have been started by a single high-energy  $\pi^0$  decaying into  $\gamma$  rays. Assuming a primary energy of  $5 \times 10^{14}$  ev ( $\epsilon_c = 500$ ), an energy of at least 15 Bev, in the center of mass system, would be obtained for the high-energy  $\pi^0$  meson. (A.C.)

#### 14730

REMARK ON STRONG INTERACTIONS. Saul Barshay

(Univ. of Copenhagen). Phys. Rev. Letters **2**, 315-18 (1959) Apr. 1.

Conservation of parity in certain of the strong interactions is discussed. The framework for the discussion was the doublet approximation, (DA), a rather high group of symmetries invoked for two classes of Yukawa-type meson-baryon interactions, the pion-baryon interactions, and the K meson-baryon interactions. There appears to be room, within the limits of the very scant knowledge of Yukawa type interactions, for possible small effects of parity nonconservation. (A.C.)

#### 14731

STRONG-COUPPLING THEORY OF THE  $S = -1$  HYPERONS: THE  $\Lambda^0$  AS A BOUND STATE. L. F. Landovitz (Brookhaven National Lab., Upton, N. Y.) and B. Margolis (Columbia Univ., New York). Phys. Rev. Letters **2**, 318-19(1959) Apr. 1.

The possibility of eliminating some of the hyperons by considering them to be bound states is discussed. The interaction of pseudoscalar pions with an isotopic spin-one baryon core in the static approximation is considered. (A.C.)

#### 14732

PROPOSAL FOR A METHOD OF POLARIZING 1-Mev DEUTERONS. Lee G. Pondrom (Aeronautical Research Lab., Wright-Patterson AFB, Ohio). Phys. Rev. Letters **2**, 346-8(1959) Apr. 15.

It is pointed out that the elastic scattering of deuterons from He<sup>4</sup> can yield a rather large deuteron polarization with a high cross section. (W.D.M.)

#### 14733

S-WAVE DETECTOR OF DEUTERON POLARIZATION AND 14-Mev POLARIZED-NEUTRON SOURCE. A. Galonsky, H. B. Willard, and T. A. Welton (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters **2**, 349-51(1959) Apr. 15.

It is pointed out that the fact that isotropy does not necessarily follow for a reaction induced by polarized s-wave deuterons may enable one to use, for example, the T(d,n)He<sup>4</sup> reaction as a sensitive detector of the polarization of a deuteron beam. This reaction will also serve as a source of polarized 14-Mev neutrons. (W.D.M.)

#### 14734

RESONANCES IN THE  $\pi$ -HYPERON SYSTEM. Michael Nauenberg (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters **2**, 351-2(1959) Apr. 15.

#### 14735

EVIDENCE FROM PHOTOPRODUCTION FOR A PSEUDOSCALAR K<sup>+</sup> MESON. Michael J. Moravcsik (Univ. of California, Livermore). Phys. Rev. Letters **2**, 352-4(1959) Apr. 15.

It has been suggested recently that the extrapolation procedure used to determine the  $\pi$ -N coupling constant from pion photoproduction angular distributions could be applied to K-meson photoproduction data to obtain the parity of the K<sup>+</sup> meson. This suggestion is discussed, and the available data are analyzed. (W.D.M.)

#### 14736

NEGATIVE K MESON-NUCLEON INTERACTION AT LOW ENERGIES. J. C. Jackson and H. W. Wyld, Jr. (Univ. of Illinois, Urbana). Phys. Rev. Letters **2**, 355-7(1959) Apr. 15.

It was recently observed that emulsion data for the total elastic scattering of K<sup>-</sup> on protons may indicate a broad peaking in the cross section at  $\sim 25$  Mev, and that this peak could be interpreted in terms of a  $J = \frac{1}{2}$

resonance of the  $K^-p$  system. An explanation of the broad peaking at low energies, within the framework of the s-wave zero-range analysis, is pointed out. If the  $K^-p$  interaction is assumed "repulsive," the destructive interference with the attractive Coulomb interaction will cause the integrated cross section to fall below the value in the absence of the Coulomb field. At low energies this effect is sufficient to cause the integral of the elastic differential cross section to behave as implied by experiment. (W.D.M.)

#### 14737

UPPER LIMIT FOR THE DECAY MODE  $\mu \rightarrow e + \gamma$ . David Berley, Juliet Lee, and Marcel Bardon (Columbia Univ., New York). Phys. Rev. Letters **2**, 357-9(1959) Apr. 15.

The search for the  $\mu \rightarrow e + \gamma$  decay mode was made by observing coincidences between a gamma detector and an electron detector placed on either side of a source of decaying positive muons. These were obtained by stopping the 60-Mev  $\pi^+$  beam of the Nevis cyclotron in a lithium target. There, the  $\pi^+$  mesons decayed into muons whose range was too short for them to escape from the target. A branching ratio of less than  $2 \times 10^{-6}$  was found with a confidence level of 90%. (W.D.M.)

#### 14738

THREE-BODY DECAYS OF  $K_2^0$  AND  $K_1^0$ . Frank S. Crawford, Jr., Marcello Cresti, Roger L. Douglass, Myron L. Good, George R. Kalbfleisch, and M. Lynn Stevenson (Univ. of California, Berkeley). Phys. Rev. Letters **2**, 361-3(1959) Apr. 15.

In the course of an associated-production experiment using the Berkeley 10-inch liquid hydrogen bubble chamber, nine "anomalous"  $K^0$  decays were found. Within their limited statistical accuracy these events (a) are consistent with equal leptonic decay rates for  $K_1^0$  and  $K_2^0$ , (b) are in good agreement with decay rates predicted by the "extended"  $\Delta I = 1/2$  rule, and (c) yield a new value for the  $K_2^0$  lifetime. (W.D.M.)

#### 14739

POSSIBLE RESONANT STATE IN PION-HYPERON SCATTERING. R. H. Dalitz and S. F. Tuan (Univ. of Chicago). Phys. Rev. Letters **2**, 425-8(1959) May 15.

It is pointed out that there is a probability for a resonant state in pion-hyperon scattering at an energy of about 20 Mev below the  $K^-p$  (C.M.) threshold energy. This possibility is discussed in some detail. Charge-dependent refinements due to the Coulomb interaction and the  $K^- \bar{K}^0$  mass difference are neglected. (W.D.M.)

#### 14740

REDETERMINATION OF THE  $\mu^+$  MEAN LIFE. R. A. Swanson, R. A. Lundy, V. L. Telegdi, and D. D. Yovanovitch (Univ. of Chicago). Phys. Rev. Letters **2**, 430-1(1959) May 15.

The muons were produced in a  $2.5\text{-g/cm}^2$  thick scintillator by the reaction  $\pi^+ \rightarrow \mu^+ \rightarrow e^+$ . The experimental set up is shown, and special equipment is discussed. A value of  $2.261 \pm 0.007\text{ }\mu\text{sec}$  was found for the  $\mu^+$  mean life. (W.D.M.)

#### 14741

$\Sigma^- - \Sigma^+$  MASS EXCESS. B. H. Bransden and R. G. Moorhouse (The University, Glasgow). Phys. Rev. Letters **2**, 431-2(1959) May 15.

It is suggested that a large part of the  $\Sigma^- - \Sigma^+$  mass splitting may be achieved by just calculating the differ-

ence in  $\Sigma^- - \Sigma^+$  self-energy graphs provided the  $\bar{K}^0(K^0) - K^-(K^+)$  mass excess is used in the calculation. The use of the K mass difference includes a great part of the electromagnetic correction to the K propagator, and it may even be the dominant part because of the quadratic dependence on cut-off of the self-mass. (W.D.M.)

#### 14742

INTERACTIONS OF 1.15-Bev/c  $K^-$  MESONS IN EMULSION. Walter H. Barkas, Nripendra N. Biswas, Donald A. DeLise, John N. Dyer, Harry H. Heckman, and Francis M. Smith (Univ. of California, Berkeley). Phys. Rev. Letters **2**, 466-8(1959) June 1.

Two groups of data are dealt with: an unbiased sample of 102 interactions and a selected group of interactions which produced more than one prong near the minimum of ionization or which gave evidence of strange particle production in the plate in which the event was located. The results of the study are as follows: (a) clear evidence for the reactions  $K^- + N \rightarrow \pi + \pi + Y$  and  $K^- + N \rightarrow K^- + N + \pi + \pi$ ; (b) evidence for the reaction  $K^- + N + N \rightarrow Y + Y + K^0$  or  $K^- + N \rightarrow \Xi^- + K^0$  followed by  $\Xi^- + N \rightarrow Y + Y$ ; (c) a possible case of a "cascade hyperfragment," that is, one which contains two units of negative strangeness; (d) no cascade particle of  $K^+$  mesons was definitely identified. (W.D.M.)

#### 14743

$\Lambda^0$  AND  $\Sigma^0$  PRODUCTION FROM THE  $(\Sigma^-, d)$  SYSTEM. T. B. Day, G. A. Snow, and J. Sucher (Univ. of Maryland, College Park). Phys. Rev. Letters **2**, 468-70(1959) June 1.

Recent measurements have been reported on the  $\Lambda^0$ ,  $\Sigma^0$  branching ratio from the absorption of  $\Sigma^-$ -hyperons in hydrogen and deuterium. It is questioned whether the results can be qualitatively understood within the framework of the simple impulse approximation. In this approximation the  $\Sigma^-$  is pictured as interacting only with the proton, and the effect of the neutron's presence is ignored. (W.D.M.)

#### 14744

MEASUREMENT OF THE  $\pi^0$  MASS, AND SEARCH FOR  $\Lambda^0$ . M. Gettner, L. Holloway, D. Kraus, K. Lande, E. Leboy, and W. Selove (Univ. of Pennsylvania, Philadelphia) and R. Siegel (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev. Letters **2**, 471-3(1959) June 1.

Since the "existence" of a second natural  $\pi$  meson, with an isotopic spin  $T = 0$ , may be expected in the reaction  $\pi^- + p \rightarrow n + \pi^0$  in addition to the ordinary  $\pi^0$  meson ( $T = 1$ ), and since the possibility that the masses of the two neutral mesons might be relatively close does not appear excluded by present knowledge, it appeared worthwhile to carry out a more direct measurement to determine the mass or masses. Results from a preliminary experiment for this purpose are reported. Although the  $\pi_0^0$  was not found, the results did not exclude its possible existence. (W.D.M.)

#### 14745

POLARIZATION OF RECOIL PROTONS FROM THE PHOTOPRODUCTION OF  $\pi^0$  MESONS FROM HYDROGEN. P. C. Stein (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters **2**, 473-5(1959) June 1.

The polarization of the proton recoils was measured at photon energies of 550 and 700 Mev at a center-of-mass angle of  $90^\circ$  by allowing the protons to be incident upon a carbon scatterer and observing the left-right



asymmetry in the scattering. The photon beam of the Cornell electron synchrotron incident upon a vacuum liquid-hydrogen target was used in the experiment. (W.D.M.)

#### 14746

RADIATIVE CORRECTIONS TO  $\pi$ -e DECAY. Toichiro Kinoshita (Cornell Univ., Ithaca, N. Y.). *Phys. Rev. Letters* 2, 477-80(1959) June 1.

An attempt is made to understand the reason why the radiative corrections to  $\pi$ -e decay calculated by Berman are so large. The question is also discussed as to whether the pion decay agrees with the recently conjectured "theorem" that the radiative correction to the total probability of a decay process is finite in the limit where the mass of the secondary electron is assumed to be arbitrarily small, although corrections to partial probabilities may be divergent in such a limit. (W.D.M.)

#### 14747

ON THE STRUCTURE OF THE CORE AND THE CENTRAL REGIONS OF EXTENSIVE AIR SHOWERS AT SEA LEVEL. S. N. Vernov, Ya. S. Babetskii, N. N. Goryunov, G. V. Kulikov, Yu. A. Nechin, Z. S. Strugalskii, and G. B. Khristiansen (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 976-84(1959) Apr. (In Russian)

Experimental data are presented relating to the spatial distribution of the energy flux of the electron-photon and nuclear-active components in the core and central regions of extensive air showers. Appreciable fluctuations in the spatial distribution of the energy flux of the electron-photon and nuclear-active components occur in the core of the showers as well as, apparently, in the central regions. Data were obtained which indicate the existence of a specific correlation between the spatial distribution of the energy flux of the electron-photon component and the spatial distribution of the energy flux of the nuclear-active component of an individual shower. (auth)

#### 14748

SCATTERING AND RESIDUAL RANGE DETERMINATIONS OF THE MASSES OF CHARGED PARTICLES IN MULTIPLATE CLOUD CHAMBERS. F. R. Arutyunyan (Inst. of Physics, Academy of Sciences, Armenian SSR). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 985-91(1959) Apr. (In Russian)

The method of determining the mass of a charged particle from its scattering and residual range in multiplate cloud chambers is experimentally checked by using it for determining the masses of protons and  $\mu$  and  $\pi$  mesons identified independently (from momentum—range data). The proton and  $\mu$ - and  $\pi$ -meson masses derived from the corresponding multiple Coulomb scattering curves are in good agreement with the correct values. (auth)

#### 14749

SPATIAL DISTRIBUTION OF THE ENERGY FLUX OF THE ELECTRON-PHOTON COMPONENT OF EXTENSIVE AIR SHOWERS. V. A. Dmitriev, G. V. Kulikov, E. I. Massalskii, and G. B. Khristiansen (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 992-1000(1959) Apr. (In Russian)

Data are presented on the spatial distribution of the energy flux of the electron-photon component of extensive air showers possessing  $1 \times 10^4$  to  $2 \times 10^6$  particles at sea level. The spatial distribution of the energy fluxes in the central part of the shower agrees with cascade theory calculations for values of the cascade

parameter  $s = 1.2$ . It is shown that with increase of distance from the shower axis the energy flux of the electron-photon component decreases more slowly than the energy flux of the nuclear-active component. Values of the energy carried by the electron-photon component in the central part of the shower are presented. (auth)

#### 14750

GENERATION OF "STRANGE" PARTICLES IN THE INTERACTION BETWEEN 9 Bev PROTONS AND PHOTOGRAPHIC EMULSION NUCLEI. N. I. Kstanashvili and O. A. Shakhulashvili (Joint Inst. of Nuclear Research, Dubna, USSR). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 1006-11(1959) Apr. (In Russian)

The frequency of generation of strange particles in collisions between high-energy protons and photographic emulsion nuclei is studied. (auth)

#### 14751

MEASUREMENT OF THE NEUTRON HALF-LIFE. A. N. Sosnovskii, P. E. Spivak, Yu. A. Prokof'ev, I. E. Kutikov, and Yu. P. Dobrynin. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 1012-18(1959) Apr. (In Russian)

The half life of the neutron was measured to be  $11.7 \pm 0.3$  min. (auth)

#### 14752

LOW ENERGY POSITRONS FROM  $\mu^+ - e^+$  DECAYS. A. O. Waisenberg. *Zhur. Eksptl'. i Teoret. Fiz.* 36, 1019-21(1959) Apr. (In Russian)

The value  $\rho = 0.72 \pm 0.10$  for the Michel parameter was obtained by analyzing available data on the spectrum of low energy positrons emitted in  $\mu^+ - e^+$  decays in photographic emulsions. (auth)

#### 14753

INVESTIGATION OF THE INTERACTION BETWEEN  $10^{11}$ — $10^{12}$  ev PARTICLES AND IRON NUCLEI. N. L. Grigorov, V. S. Murzin, and I. D. Rapoport (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 1068-79(1959) Apr. (In Russian)

The following characteristics of the interaction between  $10^{11}$  to  $10^{12}$  ev cosmic particles and iron nuclei were studied at the altitude of 3860 m with the aid of apparatus permitting one to determine the primary particle energy: (a) inelastic interaction cross section; (b) degree of inelasticity of the interaction; (c) distribution function of energy transferred to  $\pi^0$  mesons, and also some other characteristics. (auth)

#### 14754

POLARIZATION IN THE PRODUCTION OF PAIRS BY CIRCULARLY POLARIZED QUANTA. I. G. Ivanter (Inst. of Scientific Information, Academy of Sciences, USSR). *Zhur. Eksptl'. i Teoret. Fiz.* 36, 1093-7(1959) Apr. (In Russian)

An analysis is made of the cross-section formulas for bremsstrahlung and pair production by photons on a Coulomb center; the formulas are derived in the Born approximation without account of screening and recoil and for fixed polarization of all involved particles. Transformations were derived which permit one to obtain some of the formulas from the others; the transformations are employed to derive the pair production formula for circularly polarized quanta. (auth)

#### 14755

DISPERSION RELATIONS AND CHEW-LOW TYPE EQUATIONS FOR INELASTIC PROCESSES INVOLVING MESONS IN A CASE OF A FIXED SOURCE. V. Tsellner (W. Zöllner) (Joint Inst. of Nuclear Research, Dubna,

USSR). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1103-9(1959) Apr. (In Russian)

The static dispersion equations and Chew-Low equations are established for the process  $\pi + N \rightarrow n\pi + N$ . It is found that depending on how the variables are fixed, physically different dispersion relations and Chew-Low equations are obtained for the process under consideration. (auth)

#### 14756

ANALYSIS OF HIGH ENERGY SHOWERS. Ya. I. Granovskii and I. Ya. Chasnikov (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1119-22(1959) Apr. (In Russian)

The double-valued dependence of the shower particle energy on the angle of emission in the laboratory system is explained. A method is suggested for a more precise determination of  $\gamma_c$  with account of the energy and angular distribution of the shower particles. (auth)

#### 14757

MESON MASS SPECTRUM IN HEISENBERG'S THEORY. Ya. I. Granovskii (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1154-8(1959) Apr. (In Russian)

The meson mass spectrum is computed in Heisenberg's theory. Comparison of the results with the experimental data indicates that best agreement in the first approximation of the Tamm-Dancoff method is obtained for the scalar variant of the nonlinear term. (auth)

#### 14758

ON THE KINEMATICS OF ELEMENTARY INTERACTIONS. N. G. Birger and Yu. A. Smorodin (Lebedev Inst. of Physics, Academy of Sciences, USSR). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1159-67(1959) Apr. (In Russian)

Some kinematic methods of analysis of nuclear interactions of fast particles are considered. Analysis of the interactions observed in cloud chambers and photographic emulsions by this method yields the angular and energy characteristics of the interactions in the cms of the colliding particles. (auth)

#### 14759

ABSORPTION OF  $\mu^-$  MESONS BY POLARIZED NUCLEI. I. THE ANGULAR DISTRIBUTION OF NEUTRONS. E. I. Dolinskii (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1179-84(1959) Apr. (In Russian)

A calculation is carried out of the angular distribution of neutrons emitted as a result of absorption of unpolarized  $\mu^-$  mesons by polarized nuclei. (auth)

#### 14760

EMPIRICAL REGULARITIES IN THE NUCLEON PAIR PRODUCTION ENERGIES IN NUCLEI. V. A. Kravtsov (Leningrad Polytechnic Inst.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1224-32(1959) Apr. (In Russian)

The variation of the pairing energies of nucleons and of the energy of the residual (n,p) interaction of odd nucleons is investigated on the basis of the most recent experimental data. It is found that the pairing energy not only depends on the total angular momentum of the nucleons but also on the position of the pair in the nuclear shell and on the deformation of the nucleus. The decrease of the pairing energy with mass number A is slower than that predicted by the theory. The pairing energy is only slightly changed if two nucleons of different types are added to the nucleus. The energy of the residual (n,p) interaction of odd nucleons is not

zero, decreases with A, and is smaller than the pairing energy. (auth)

#### 14761

ON THE DEVELOPMENT OF THE NUCLEAR-ACTIVE COMPONENT OF EXTENSIVE ATMOSPHERIC SHOWERS. S. N. Vernov, E. V. Gorchakov, I. P. Ivanenko, and G. B. Khristiansen (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1233-9(1959) Apr. (In Russian)

The spectrum of the nuclear-active particles in extensive atmospheric showers and the particle and absorption ranges are computed, and the rate of structure bursts is estimated on the basis of some simple assumptions regarding the nature of the elementary act. It is shown that besides extensive atmospheric shower characteristics which weakly depend on the nature of the elementary act there are characteristics which are sensitive to the latter. (auth)

#### 14762

ON SUPERFLUIDITY OF A SYSTEM OF BOSE POLAR EXCITATIONS. S. V. Vonsovskii and M. S. Svirskii (Inst. of Metal Physics, Academy of Sciences, USSR). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1259-66(1959) Apr. (In Russian)

The possibility of a superconducting state in metals is investigated in the case when the elementary current excitations of the electron system are quasi-bosons. The problem is solved by the Bogolyubov method within the framework of the polaron many-electron crystal mode. The conditions for possible existence of the superconducting state in a system of charged bosons were deduced (low temperatures, low density of the quasi-particles, practical absence of single-electron transitions, and negative sign of the exchange integral). The phonon induced interaction between the current Bose particles is of an attractive character and impedes the appearance of the superconducting properties of the latter. The dependence of the critical temperature of a superconductor with Bose current carriers on the crystal ion isotopic mass differs from that of a metal with a Fermi electron spectrum. This difference can be exploited to experimentally differentiate between Fermi and Bose superconductors. (auth)

#### 14763

ANOMALOUS SPINORS AND BOSONS. A. M. Brodskii and D. D. Ivanenko (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1279-85(1959) Apr. (In Russian)

Spinors and bosons are considered which behave unusually under inversions and which obey anomalous commutation relations, indicated by Gelfand and Zetlin. The possibility of describing various particles by means of unusual wave functions is discussed. (auth)

#### 14764

ON  $\beta$  DECAY OF STRANGE PARTICLES. V. M. Shekhter (Leningrad Inst. of Physics and Tech.) *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1299-1301(1959) Apr. (In Russian)

In order to determine the order of F constants, an analysis was made of the  $K_{e3}$  and  $K_{\mu 3}$  decays, the probability of which can be determined by the matrix element of the same interaction which leads also to hyperon  $\beta$  decay. (R.V.J.)

#### 14765

ANGULAR CORRELATION  $e - \nu$  IN FREE NEUTRON  $\beta$  DECAY. Yu. V. Trebukhovskii, V. V. Vladimirovskii, V. K. Grigor'ev, and V. A. Ergakov. *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1314-16(1959) Apr. (In Russian)



The angular correlation  $e-\nu$  in free neutron decay was determined by means of electron decay spectra. The graphical scheme of the installation is presented. The collimated, 35-mm diameter neutron beam from a heavy water reactor penetrated through an aluminum vacuum chamber containing the detectors and magnetic lenses for focusing the decay electrons and recoil protons. Two toroidal magnetic lenses placed in succession were used for selecting electrons by pulses. The resolving power of the spectrometer was  $\pm 3\%$ . Studies were made of the triple coincidences between the proton and electron detectors. To compensate the proton time-in-flight, the pulses from double coincidences were retarded 1.3  $\mu\text{sec}$  in relation to the proton detector pulses. The resolving time of the triple coincidences was 0.7  $\mu\text{sec}$ . The result derived by the method of least squares was  $\lambda = 0.06 \pm 0.13$ . (R.V.J.)

**14766**

ON THE  $K_{e3}$  AND  $K_{\mu 3}$  DECAYS. S. G. Matinyan and L. B. Okun (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 36, 1317-19(1959) Apr. (In Russian)

The A-V interaction scheme in  $\beta$  decay,  $\mu$  and  $\pi$  decay, and decay of strange particles ( $\Lambda^0$  hyperon,  $K_{\mu 2}$  decay) was previously verified by a series of experiments. In connection with the above, experiments were carried out with triple lepton K decays  $K \rightarrow l + \nu + \pi$ , where l is an electron or  $\mu$  meson. (R.V.J.)

**14767**

ON THE  $\pi^-$  AND  $\mu^-$  MESON PAIR PRODUCTION DURING ANNIHILATION OF HIGH ENERGY POSITRONS. A. I. Nikishov (Lebedev Inst. of Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz. 36, 1323-4(1959) Apr. (In Russian)

The processes  $e^+ + e^- \rightleftharpoons \mu^+ + \mu^-$ ,  $e^+ + e^- \rightleftharpoons \pi^+ + \pi^-$  were studied in order to find deviations from the local theory at the distance of  $\sim 10^{-13}$  cm. (R.V.J.)

**14768**

ON PAIR PRODUCTION IN COLLISION OF TWO LONGITUDINALLY POLARIZED  $\gamma$  QUANTA. F. S. Sadykhov and B. K. Kerimov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 36, 1324-6(1959) Apr. (In Russian)

The electron-positron pair production in collisions between two longitudinally polarized  $\gamma$  quanta was calculated considering the longitudinal polarization of the produced pair. The problem is of special interest since the high-energy ( $E_\gamma = 0.5$  to 1 Bev)  $\gamma$  beams and  $\gamma$  quanta with longitudinal polarization appearing in bremsstrahlung of longitudinally polarized high-energy electrons and in nuclear  $\beta$  decay are already known. (R.V.J.)

**14769**

ON THE MECHANISM OF HYPERON LEPTON DECAY. V. V. Turovtsev (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz. 36, 1326-7(1959) Apr. (In Russian)

**14770**

ANGULAR DISTRIBUTION ASYMMETRY OF ELECTRONS IN  $\mu^+ \rightarrow e^+$  DECAY IN MAGNETIC FIELDS AT 27,000 G. S. A. Ali-Zade, I. I. Gurevich, Yu. P. Dobretsov, B. A. Nikol'skii, and L. V. Surkova. Zhur. Eksptl'. i Teoret. Fiz. 36, 1327-9(1959) Apr. (In Russian)

**14771**

ON DETERMINATION OF MUON SPIRALITY BY  $\delta$  ELECTRON SHOWERS FROM MAGNETIZED IRON. A. I. Alikhanov and V. A. Lyubimov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR).

Zhur. Eksptl'. i Teoret. Fiz. 36, 1334-5(1959) Apr. (In Russian)

Experiments were carried out with cosmic rays and cyclotrons in order to determine the direction and the polarization magnitude of muons. (R.V.J.)

**14772**

ON THE POSSIBILITY OF MASS SEPARATION OF RELATIVISTIC CHARGED PARTICLES BY MEANS OF WAVE GUIDES WITH TRAVELING WAVE. D. V. Volkov (Khar'kov Inst. of Physics and Tech.). Zhur. Tech. Fiz. 29, 414-16(1959) Mar. (In Russian)

A method using wave guides for separating charged particles from a beam is suggested for the case where electrons accelerated in a linear accelerator are used as the initial beam. (R.V.J.)

## Heat Transfer and Fluid Flow

**14773** AFOSR-TN-59-107

Cornell Aeronautical Lab., Inc., Buffalo. GASDYNAMICS OF A WAVE SUPERHEATER FACILITY FOR HYPERSONIC RESEARCH AND DEVELOPMENT. R. C. Weatherston, A. L. Russo, W. E. Smith, and P. V. Marroñe. Feb. 1959. 147p. Contract AF18(603)-141. (CAL-AD-1118-A-1; AD-210223).

This report treats the wave superheater, a unique device to produce a continuous, supersonic flow of uncontaminated air or other gases at temperatures and pressures needed for realistic hypersonic testing in the laboratory. The fundamental principles of wave superheater design and operation are developed. In particular, the gas dynamic and heat transfer aspects of one version, which is designed to generate 9000°R in uncontaminated air, are discussed. (auth)

**14774**

FLOWS WITH FINITE ENTROPY. Ya. Sinai (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 125, 1200-2(1959) Apr. 21. (In Russian)

The existence of transient flow with a multiple Leberg spectrum and arbitrary finite  $h_s > 0$  is found. (R.V.J.)

**14775**

THE BASIC EQUATION FOR THE HEAT EXCHANGE IN HYDRODYNAMIC THEORY. P. N. Pinsker. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Energet. i Avtomat. No. 1, 26-32(1959). (In Russian)

A system of equations for heat exchange in compressible and incompressible turbulent flow was analyzed considering the effects of a laminar (viscous) sublayer. A method is suggested for integrating the initial system of flow with the pressure gradient where the velocity profile in the boundary layer and the friction coefficient bond with the boundary layer thickness are expressed by power functions. (tr-auth)

**14776**

A METHOD OF CORRELATING BURNOUT HEAT FLUX DATA. G. Sonnemann (Univ. of Pittsburgh). Nuclear Sci. and Eng. 5, 242-7(1959) Apr.

Analysis of burnout heat flux is undertaken by considering the burnout heat flux to be the sum of the flux required to initiate nucleate boiling and of an incremental flux required to cause burnout. For data taken at a pressure of 2000 psia, the method of analysis correlated the majority of the data with an accuracy of  $\pm 17$  per cent. (auth)

**14777**

A NON-STATIONARY HEAT EXCHANGE OF AN INFI-

NITE ISOTHERMIC CYLINDER WITH A SEMI-INFINITE BODY. I. A. Ioffe. *Zhur. Tekh. Fiz.* 29, 417-22(1959) Mar. (In Russian)

A solution was derived for a plane, non-stationary heat conduction problem for a semi-infinite body with an internal isothermic heat source with constant temperature at the finite plane. Equations are developed for the temperature range and heat consumption. The solution was derived by means of integral equations and simple approximations. Evaluations were made of the possible errors. (tr-auth)

#### 14778

A SUPPLEMENT TO "HELIUM." E. M. Lifshits and E. L. Andronikashvili. Translated from Russian. New York, Consultants Bureau, Inc., 1959. 171p.

This volume contains two chapters entitled Superfluidity (Theory) and Superfluidity (Experimental Data). (W.L.H.)

## Nuclear Properties and Reactions

#### 14779 AD-145219

North Carolina State Coll., Raleigh.  
A RANGE MEASUREMENT OF THE ALPHA-PARTICLE FROM THE  $B^{10}(n,\alpha)Li^7$  REACTION (thesis). Donald Robert Griesher. 1957. 27p.

The possibility of measuring the range of the ejected alpha particle in the  $B^{10}(n,\alpha)Li^7$  reaction using a Rosenblum-type spark counter with a rod cathode and a fine wire anode was investigated. Boron, deposited on a metal backing plate, was bombarded by thermal neutrons resulting from diffusion through paraffin of fast neutrons from a 500-mc BaBe source. The spark counter furnishes a convenient and accurate method of measuring  $\alpha$ -particle ranges. The range obtained was  $0.68 \pm 0.01$  cm, in good agreement with the accepted range of  $0.72 \pm 0.015$  cm. (A.C.)

#### 14780 AD-154995

Texas Nuclear Corp., Austin.  
NEUTRON INTERACTIONS IN Fe, Pb, AND Ni.  
Norman A. Bostrom, Ira L. Morgan, J. Thomas Prud'homme, and Pablo L. Okhuysen. Feb. 14, 1958. 64p. Contract AF33(616)-5111.

A study of the interaction of fast neutrons in iron and lead has led to an investigation of the energy distribution of inelastically scattered neutrons, gamma ray production cross sections due to inelastic neutron scattering, the angular distribution of intense gamma rays due to inelastic neutron scattering, and the production of high energy gamma rays due to neutron capture. The associated particle, time-of-flight technique was employed in determining the energy distribution of inelastically scattered neutrons at  $E_n = 14.9$  Mev. Gamma ray production cross sections in iron and lead were measured at  $E_n = 1.0, 3.51, 3.82, 4.11, 4.36, 4.61$ , and  $14.9$  Mev. Cross sections for production of  $2.62$  Mev gamma rays due to inelastic scattering in  $Pb^{208}$  were measured in 200 kev intervals in the energy region of  $3.0$  to  $4.5$  Mev. The angular distribution of gamma rays emitted from the  $0.843$  Mev level in iron was determined at  $E_n = 4.61$  Mev. Production cross section for  $6.0$  and  $8.0$  Mev gamma rays due to capture in nickel and lead was measured in the neutron energy region of  $0.100$  to  $1.0$  Mev. (auth)

#### 14781 AECU-4126

Los Alamos Scientific Lab., N. Mex.  
THE  $B^{11}(\alpha,n)N^{14}$  REACTION (thesis). Eugene Haddad,

Nov. 1958. 129p. Contract [W-7405-eng-36]. \$19.80 (ph), \$6.30 (mf) OTS.

Submitted to the Univ. of Utah.

$He^+$  ions from the large Los Alamos electrostatic accelerator were used to bombard thin  $B^{11}$  targets, and the resulting neutron spectra were measured by a time-of-flight method. The absolute zero-degree differential cross section was obtained for the  $B^{11}(\alpha,n)N^{14}$  reaction for the alpha-particle energy range from  $1.9$  to  $6.9$  Mev, the  $B^{11}(\alpha,n)N^{14*}$  reaction from  $3.5$  to  $6.9$  Mev, and the  $B^{11}(\alpha,n)N^{14*}$  reaction from  $5.3$  to  $6.9$  Mev. Resonances were found in the zero degree cross section curves at excitation energies in  $N^{15}$  corresponding to  $12.51, 12.90, 13.14, 13.17, 13.36, 13.60, 13.71, 13.85, 14.08, 14.16, 14.63, 14.90, 15.01, 15.08, 15.29, 15.37, 15.61, 15.92, 15.93, 15.99$ , and  $16.04$  Mev. Angular distributions were obtained for the neutrons associated with the ground state transition for the alpha-particle energy range from  $1.92$  to  $5.72$  Mev and for the first excited state from  $3.73$  to  $4.74$  Mev. From the angular distributions, values for the total reaction cross section were obtained for the  $B^{11}(\alpha,n)N^{14}$  reaction for the energy region from  $1.92$  to  $5.72$  Mev. The angular distributions for alpha-particle energies above  $2.05$  Mev were found to exhibit asymmetry about  $90^\circ$  in the center-of-mass system while the angular distribution at  $2.05$  Mev was symmetric about  $90^\circ$ . A theoretical analysis of the  $12.50$ -Mev state in  $N^{15}$  led to a spin and parity assignment of  $5^+_{1/2}$ . Qualitative arguments are used to show that the  $12.90$ -Mev state in  $N^{15}$  is not a pure state. (auth)

#### 14782 AECU-4128

Los Alamos Scientific Lab., N. Mex.  
14-YEAR  $^{113m}Cd$ . Arthur C. Wahl. [195?]. 9p. Contract [W-7405-eng-36]. \$1.80(ph), \$1.80(mf) OTS.

The half lives of  $Cd^{113m}$  and  $Cd^{115m}$  have been re-determined to be  $14 \pm 2$  years and  $44.2 \pm 0.5$  days, respectively. The ratio of  $Cd^{113m}/Cd^{115m}$  yields from thermal-neutron fission of  $U^{235}$  is  $0.27 \pm 0.03$ , and the ratio of  $(n,\gamma)$  formation cross sections is  $0.31 \pm 0.03$ . Combination of these ratios with literature values for the  $Cd^{115m}$  fission yield and  $(n,\gamma)$  formation cross section gives  $(1.9 \pm 0.2) \times 10^{-4} \%$  and  $43 \pm 10$  mb for the  $Cd^{113m}$  fission yield and  $(n,\gamma)$  formation cross section, respectively. (auth)

#### 14783 AFOSR-TN-57-636

Boston Univ.  
AN EXPERIMENTAL STUDY OF THE REACTION  $Al^{27}(d,n)Si^{28}$  (thesis). Allen G. Rubin. 1957. 138p. Contract [AF18(600)-997]. (AD-136623).

The neutron spectrum and angular distributions of neutron groups from  $Al^{27}(d,n)Si^{28}$  were obtained by the method of proton recoils in nuclear emulsions. A thin aluminum target was bombarded with  $2.16$  Mev deuterons, and neutrons were detected by means of  $400 \mu$  Ilford C-2 emulsions placed at nine angles to the incident beam. The plates were scanned with a Leitz binocular microscope equipped with a moving stage, at  $1000$  magnification. Neutron spectra were obtained at eight angles;  $0, 10, 20, 30, 45, 60, 90$ , and  $120^\circ$ . A total of  $12,500$  tracks was scanned. [Excited states of  $Si^{28}$  were obtained at  $1.78 \pm 0.10, 4.54 \pm 0.2, 4.95 \pm 0.2, 6.24 \pm 0.06, 6.88 \pm 0.06, 7.39 \pm 0.06, 7.89 \pm 0.06, 8.31 \pm 0.10, 8.57 \pm 0.08, 9.37 \pm 0.04, 10.00 \pm 0.10$ , and  $10.25 \pm 0.06$  Mev. The cross-section for formation of the  $9.37$  state at  $0^\circ$  is  $10.1$  mb per steradian, within a factor of two.] A second bombardment for the same reaction was made with a bombarding energy of  $6.00$  Mev in order to obtain valid stripping angular distributions.  $400 \mu$  Ilford



C-2 emulsions were used at nine angles to the incident beam, at  $15^\circ$  intervals from  $0$  to  $135^\circ$ . Neutron spectra were obtained at six of these angles. The angular distributions obtained were compared with the Butler stripping theory in order to obtain the parities and limits on the spins of the states in  $\text{Si}^{28}$  which were reached in the reaction. The angular distributions of neutron groups corresponding to the levels at 1.78, 6.24, 7.90, 8.57, and 9.39 Mev states are adequately described by  $l = 0$  distributions. [The angular distribution of the unresolved states at 4.6 and 5.0 Mev was obtained, and the principal peak matches a Butler  $l = 1$  distribution. The states at 6.88 and 7.39 Mev were poorly resolved, and did not fit Butler distributions very well. An  $l = 2$  distribution was obtained for the ground state of  $\text{Si}^{28}$  as expected.] The cross-section for formation of the 9.39 Mev state of  $\text{Si}^{28}$  at  $0^\circ$  at 2.16 Mev bombarding energy is  $10.1 \pm 5$  mb per steradian, and at 6.00 Mev bombarding energy  $30.6 \pm 8$  mb per steradian. The angular distributions obtained from this exposure followed the Butler predictions quite closely, out to the largest angles studied. A thorough analysis of the low bombarding energy angular distributions was not carried out. A thin target of isotopic boron was bombarded with 7.03 Mev protons. The neutrons from the  $\text{B}^{11}(\text{p},\text{n})\text{-C}^{11}$  reaction, studied by means of nuclear emulsions, indicate an excited state of  $\text{C}^{11}$  at  $2.01 \pm 0.06$  Mev. The reaction  $\text{P}^{31}(\text{p},\text{n})\text{S}^{31}$  was studied at  $E_p = 17.2$  Mev. The energy spectrum of the neutrons was determined by means of proton recoil measurements in nuclear emulsions. The mass excess,  $M - A$ , of  $\text{S}^{31}$  was calculated to be  $-10.04 \pm 0.20$  Mev. [Excited states of  $\text{S}^{31}$  were located at  $1.15 \pm 0.15$ ,  $2.28 \pm 0.20$ ,  $3.35 \pm 0.20$ ,  $4.51 \pm 0.15$ ,  $5.94 \pm 0.30$ , and  $6.41 \pm 0.20$  Mev.] (auth)

**14784** AFOSR-TN-59-433  
Vanderbilt Univ., Nashville and Western Reserve Univ., Cleveland.

LOW-INTENSITY CONVERSION LINES IN TWO WEAKLY DEFORMED NUCLEI. W. T. Achor, W. E. Phillips, J. I. Hopkins, and S. K. Haynes. May 12, 1959. 30p. Contracts AF18(603)-61, AT(40-1)-268, and AT(40-1)-1322. (AD-214795). \$4.80(ph), \$2.70(mf) OTS.

The electron spectrum of  $\text{Sm}^{151}$  was measured with a lens spectrometer and its gamma-ray spectrum with a scintillation spectrometer. The L-conversion coefficient of the  $21.7 \pm 0.3$  kev de-excitation of the first excited state of  $\text{Eu}^{151}$  is  $20 \pm 4$ , with  $\alpha_L/\alpha_{M+N} = 2.2 \pm 0.4$  and  $\alpha_M/\alpha_N = 2.2 \pm 0.2$  indicating M1 multipolarity. The low intensity of the conversion electrons relative to the continuous beta spectrum of end point  $75.9 \pm 0.6$  kev implies the existence of a weak beta transition whose end point is  $54.2 \pm 0.7$  kev. The beta branching ratio  $54.2\text{-kev transitions}/75.9\text{ kev transitions}$  is  $1.7/100$ . (auth)

**14785** NP-7594  
Rio de Janeiro. Centro Brasileiro de Pesquisas Físicas. THE POLES OF THE S-MATRIX OF A RECTANGULAR POTENTIAL WELL OR BARRIER. H. M. Nussenzveig. 1958. 36p. (Notas de Física Vol. IV, No. 26).

To test the validity of current ideas on the poles of the S-matrix, a simple example is treated: nonrelativistic scattering by a spherically symmetric rectangular potential well (or barrier). The poles of the S-function associated with this problem, in the case of zero angular momentum, are determined, and their behavior as a function of the well depth (barrier height) is discussed.

Some results for higher angular momenta are also given. The usual physical interpretation may be applied only to a very restricted class of poles. Difficulties appear in the case of "short-lived decaying states." However, the present model leads to a connection between the limiting cases of strongly bound states in a deep well and of certain characteristic states attached to a "hard sphere" or to a perfect conductor (antenna). It is shown that some poles, previously described as "meaningless," give rise to important physical effects. (auth)

**14786** UCRL-8710  
California, Univ., Berkeley. Lawrence Radiation Lab. INDEPENDENT YIELDS OF ISOMERIC PAIRS IN NUCLEAR REACTIONS (thesis). Sylvia Mae Bailey. Apr. 1959. 85p. Contract W-7405-eng-48. \$2.25(OTS).

The  $\text{Cd}^{115\text{m}}$  and  $\text{Cd}^{115}$  isomers produced in 12- to 340-Mev proton bombardments of  $\text{U}^{238}$  were isolated by radiochemical methods. The cumulative yield ratios of  $\text{Cd}^{115}/\text{Cd}^{115\text{m}}$  were determined. In the 45-Mev helium-ion fission of uranium, an estimation of the independent-yield ratio of  $\text{Pm}^{148}$  (5.3-day) to  $\text{Pm}^{148}$  (43-day) was made. In the deuteron fission of uranium at about 20 Mev, an estimate of the independent-yield ratio of  $\text{Nb}^{95\text{m}}$  to the total niobium of mass 95 was made. A literature survey on experimental isomer ratios from fission was made. The yield ratio of  $\text{Sc}^{44\text{m}}/\text{Sc}^{44}$  was measured in  $\text{Sc}^{45}(\alpha,\text{n})\text{Sc}^{44}$  reactions with helium ions of energies between 20 and 43 Mev and at 320 Mev. The  $\text{Sc}^{44\text{m}}/\text{Sc}^{44}$  ratio was measured in  $\text{K}^{41}(\alpha,\text{n})\text{Sc}^{44}$  reactions at 10 and 43 Mev. The compound-nucleus model was used to calculate the  $\text{Sc}^{44\text{m}}/\text{Sc}^{44}$  ratios produced by the reactions  $\text{K}^{41}(10\text{-Mev } \alpha,\text{n})\text{Sc}^{44}$  and  $\text{Sc}^{45}(\alpha,\text{n})\text{Sc}^{44}$  and  $\text{Sc}^{45}(\text{p,pn})\text{Sc}^{44}$  at energies 0.4 Mev above threshold. Agreement between the experimental and calculated  $\text{Sc}^{44\text{m}}/\text{Sc}^{44}$  ratio was obtained for the  $\text{K}^{41}(10\text{-Mev } \alpha,\text{n})\text{Sc}^{44}$  reaction. A classical knock-on model was used to calculate the  $\text{Sc}^{44\text{m}}/\text{Sc}^{44}$  ratio from a  $\text{Sc}^{45}(\alpha,\text{n})\text{Sc}^{44}$  or  $\text{Sc}^{45}(\text{p,pn})\text{Sc}^{44}$  reaction in which the charged particle strikes a neutron and both particles go out. This calculated isomer ratio agreed fairly well with the experimental isomer ratio for 320-Mev helium ions which are assumed to have such a small wave length that the projectile interacts classically with only one nucleon. It is assumed that the  $\text{K}^{41}(43\text{-Mev } \alpha,\text{n})\text{Sc}^{44}$  and the  $\text{Sc}^{45}(\alpha,\text{n})\text{Sc}^{44}$  reactions in the 20- to 43-Mev energy range occur by means of a direct-interaction mechanism. (auth)

**14787** AEC-tr-3685  
THE NUCLEAR RESONANCE GAMMA-RAY FLUORESCENCE IN  $\text{Ir}^{191}$ . Rudolf L. Moessbauer. Translated for Los Alamos Scientific Lab. from *Z. Physik* **151**, 124-43 (1958). 30p. \$4.80(ph), \$2.70(mf) JCL.

The nuclear resonance absorption of the 129-kev gamma that follows the decay of  $\text{Os}^{191}$  is examined. The capture cross section for the resonance absorption is measured as a function of the temperatures of the source and absorber in a temperature region of  $90^\circ\text{K} < T < 370^\circ\text{K}$ . The life time  $\tau_\gamma$  of the 129-kev level in  $\text{Ir}^{191}$  is shown to be  $\sim 3.6 \times 10^{-10}$  sec. The absorption cross section shows a marked increase at low temperatures as a result of the crystal bond of the absorber and preparation substances. Lamb's theory of the resonance absorption of slow neutrons in crystals is applied to the nuclear resonance absorption of gamma radiation. At low temperatures, there is evinced a strong dependence of the capture cross section for the nuclear absorption upon the frequency distribution in the solid's oscillation spectrum. (auth)

## 14788

THE THEORY OF THE SATURATION OF NUCLEAR FORCE. Witlof Brunner (Deutsche Akademie der Wissenschaften, Berlin). *Ann. Physik* 3, 137-54(1959). (In German)

A calculation of the binding energy of the nucleus was given with the use of a relatively simple nuclear model. The description of the nucleon as a non-interacting Fermi gas is the starting point. The corresponding kinetic energy with consideration of a supplementary part limited by the "hard core" of the nucleon was given according to an interpolation formula of London. The calculation of the potential energy results from a survey of the totality of the nucleons with their meson fields in a system of coupled fields, the source (nucleon) field, and the meson field. While the representation of the theory in general form results, for the numerical evaluation of the equations a Ritz approximation is used. Approximately 7 Mev was obtained as the binding energy per nucleon with a reasonable value for the nuclear radius. The result indicates that a stabilization of nuclear matter at normal densities is possible only through the interaction of kinetic energy and meson (two particle) energy and that a description of the totality of the nucleons is meaningful through a system of coupled fields (as far as shell properties are negligible). (tr-auth)

## 14789

APPLICATION OF A SIMPLE VARIATION METHOD TO THE BINDING ENERGY OF LIGHT NUCLEI. W. Inthoff (Universität, Mainz.). *Ann. Physik* 3, 220-32(1959) (In German)

From the Hartree-Fock energy expression with the eigenfunctions of harmonic oscillators and a simple addition for the spin-orbit angular momentum interaction, equations for the binding energy were formulated. By application of the variation method in the simple form of coordinate space, additional equations were obtained. Equations for the interaction parameter resulted from the comparison with the empirical binding energy and from extreme conditions. The "nuclear radii" were calculated, and an estimation for the tensor interaction was given. (tr-auth)

## 14790

ON THE PRODUCTION OF ELEMENT 102. P. R. Fields, A. M. Friedman, J. Milsted, H. Atterling, W. Forsling, L. W. Holm, and B. Aström (Nobel Inst. of Physics, Stockholm). *Arkiv Fysik* 15, 225-8(1959).

In 1957 the present authors reported the production of an isotope of element 102. By similar experiments made at Berkeley and in Moscow alpha disintegrations attributed to this element have also been found. At Berkeley, attempts to reproduce the results were unsuccessful. This has prompted us to make a thorough re-examination of the experimental data. Some comparisons between the Berkeley and the Stockholm experiments are discussed. The re-investigation has not led to any new conclusions regarding the earlier interpretation of results. (auth)

## 14791

INELASTIC SCATTERING OF PROTONS BY  $O^{16}$ . L. Egardt and S. O. Lundqvist (Univ. of Uppsala, Sweden). *Arkiv Fysik* 15, 237-40(1959).

A brief report is given on some preliminary calculations on proton inelastic scattering by  $O^{16}$  at 180 Mev. The transition from the ground state to the excited state is treated as the result of a single nucleon-nucleon collision described by the t-matrix for free nucleon-

nucleon collisions. The neglect of the spin-orbit part and distortion of the waves on account of Coulomb interaction do not introduce serious errors. The 6.14-Mev level was studied, which was treated in the LS coupling as an excitation from the ground state  $S^4p^{12}$  with  $L = S = T = 0$  to the state  $L = 3, S = T = 0$  in the  $S^4p^{14}d^1$  configuration. (T.R.H.)

## 14792

INFLUENCE OF ODD-ORDER NUCLEAR DEFORMATIONS ON THE ELECTRON CORTEGE. M. Demeur and J. Lardinois (Université Libre, Brussels). *Bull. classe sci., Acad. roy. Belg.* 44, 964-70(1958). (In French)

The contribution of the Sternheimer effect to the spectroscopic observation of odd-order nuclear deformations is examined. The degenerate electron states capable of participating in the Casimir octupole effect are identified. (tr-auth)

## 14793

DETERMINATION OF THE PERCENTAGE OF ISOMERIC TRANSITIONS BY AN ABSORPTION METHOD. P. C. Capron and A. Vander Stricht (Université, Louvain, Belgium). *Bull. classe sci., Acad. roy. Belg.* 44, 1008-14(1958). (In French)

The possibility of measuring the isomeric transition percentage and the cross section ratio of nuclear isomers by a simple absorption method is discussed. (tr-auth)

## 14794

THE HALF-LIFE OF  $Pb^{210}$  (RaD). B. D. Pate, C. C. Santry, and L. Yaffe (McGill Univ., Montreal). *Can. J. Chem.* 37, 1000-1(1959) May.

A  $4\pi$  proportional counter was used to measure the half life of  $Pb^{210}$ . A purified source was arranged so that all emitted radiation was absorbed except the beta radiation from  $Bi^{210}$ . Activity measurements were carried on for 5 years. The data yielded a value of 23.30 years. (J.R.D.)

## 14795

INTERACTION MODES IN BETA DECAY. DECAY OF  $Na^{24}$ . N. A. Burgov and Yu. V. Terekhov (Academy of Sciences, USSR, Moscow). *Nuclear Phys.* 10, 541-51 (1959) Apr. (2).

Electron-neutrino correlation in the  $\beta$  decay of  $Na^{24}$  was investigated. The method of observation is based on the effect of nuclear resonance scattering of the  $\gamma$  rays of  $Mg^{24}$  accompanying the  $\beta$  decay of  $Na^{24}$ . A gaseous source of  $Na^{24}$  was used. The most probable value of the correlation constant which is in agreement with the measurements proved equal to  $\lambda = -(0.22 \pm 0.12)$ . If the isobaric spin and the experiments on the circular polarization of the  $\gamma$  rays of  $Na^{24}$  is taken into consideration, then it appears that the  $\beta$  decay of  $Na^{24}$  is due only to interaction of the Gamow-Teller type. It follows then that only the axial vector mode of interaction, corresponding to  $\lambda = -1/3$ , should be effective. (auth)

## 14796

INVESTIGATION OF THE 16.1 Mev EXCITATION LEVEL OF  $C^{12}$ . L. Keszthelyi and I. Fodor (Central Research Inst. for Physics, Budapest). *Nuclear Phys.* 10, 564-70(1959) Apr. (2).

The radiation width for the transition to the ground state of the 16.1-Mev excitation level of  $C^{12}$  was determined by measuring the resonant absorption of  $\gamma$ -rays. The level width was found to be  $7.5 \pm 1.9$  ev. The square of the matrix element for E2 transition, expressed in Weisskopf units, is  $2.17 \pm 0.55$ . (auth)



**14797**

THE  $Y^{89}(n,\gamma)Y^{90}$  REACTION. G. A. Bartholomew, P. J. Campion, J. W. Knowles, and G. Manning (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nuclear Phys. **10**, 590-605 (1959) Apr. (2).

The thermal neutron capture gamma rays from the  $Y^{89}(n,\gamma)Y^{90}$  reaction were investigated in the energy region between 0.18 and 7.0 Mev with a pair spectrometer, a flat crystal spectrometer, and an angular correlation arrangement using two sodium iodide crystals. The prominent gamma rays in the spectrum, which is unusually simple for a nucleus of this mass number, can be fitted to a level diagram for  $Y^{90}$  with levels at  $0.2024 \pm 0.0003$ ,  $0.247 \pm 0.002$ ,  $0.7767 \pm 0.0002$ ,  $1.215 \pm 0.002$ , and  $2.741 \pm 0.012$  Mev. Angular correlation studies between cascading gamma rays, with certain assumptions based on the gamma ray intensities, lead to tentative assignments of  $2+$  and  $3-$  for the levels at 0.7767 and 0.2024 Mev, respectively. The neutron binding energy of  $Y^{90}$  is found to be  $6.849 \pm 0.009$  Mev. The observed level scheme is compared with shell model predictions. (auth)

**14798**

TIME-REVERSAL AND POLARIZED NUCLEAR REACTIONS. L. C. Biedenharn (University of Copenhagen). Nuclear Phys. **10**, 620-5 (1959) Apr. (2).

The generalized polarization-asymmetry theorem requires only reciprocity and not reversibility. The application of this result to complex potentials is discussed in detail. (auth)

**14799**

PILE OSCILLATOR MEASUREMENTS OF ETA. C. O. Muehlhause (National Bureau of Standards, Washington, D. C.). Nuclear Sci. and Eng. **5**, 225-6 (1959) Apr.

Values for the number of neutrons produced per thermal neutron absorbed,  $\eta_{th}$ , in the three fissile materials  $U^{233}$ ,  $U^{235}$ , and  $Pu^{239}$  are reported. The measurement of these quantities was performed between the years 1951 and 1953 at the Argonne National Laboratory using the original enriched heavy water reactor, CP3', and the technique of pile oscillation. A slight revision of the data has been made on the basis of new total cross sections and f-values. The eta values at thermal energy (0.0253 ev) were found to be  $\eta_{23} = 2.25 \pm 0.03$ ,  $\eta_{25} = 2.05 \pm 0.03$ , and  $\eta_{49} = 2.04 \pm 0.04$ . (auth)

**14800**

PILE NEUTRON CAPTURE CROSS SECTIONS OF  $Np^{239}$ . E. M. Kinderman, H. W. Lefevre, and H. H. Van Tuyl (General Electric Co., Richland, Wash.). Nuclear Sci. and Eng. **5**, 264-8 (1959) Apr.

An activation method was used to measure the neutron capture cross sections of  $Np^{239}$ . Two isomers of  $Np^{240}$  have been reported: a 7-min daughter of  $U^{240}$  and a 1-hr isomer produced by alpha bombardment of  $U^{238}$ . Examination with a gamma scintillation spectrometer of the activity produced by neutron activation of  $Np^{239}$  gave positive evidence for the 7-min isomer as a product of neutron capture in  $Np^{239}$ . The 1-hr isomer is also produced, although the evidence for it was complicated by fission product activity. Genetic linkage between the isomers was not detected and is less than 5 per cent. The measured cross sections for pile neutrons are  $31 \pm 6$  barns and  $18^{+18}_{-10}$  barns for the 7-min and 1-hr isomers. These values are based upon a 2.8 per cent abundance of the 1.5-Mev gamma of the 7-min isomer and a 38 per cent abundance for the 0.97-Mev gamma of

the 1-hr isomer. These results are relative to a gold thermal cross section of 99 barns. (auth)

**14801**

THE EJECTION OF ATOMS FROM GOLD CRYSTALS DURING PROTON IRRADIATION. M. W. Thompson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8) **4**, 139-41 (1959) Jan.

Protons from a Van de Graaff generator were passed through air into a 0.002-in. gold foil rolled to produce a cubic texture. The foil was cooled to prevent evaporation. A total dose of  $3.4 \times 10^{16}$  protons was received by 0.1  $cm^2$  of the foil. The ejected atoms were collected on an Al-plated silica collector cooled to  $-150^\circ C$ , and they were identified by neutron activation. The results are interpreted as indicating that momentum transferred in the initial proton-atom collision is resolved into pulses travelling along the close-packed lines of atoms. If a pulse is not too far attenuated by the time it reaches the surface, the last atom is ejected. (T.R.H.)

**14802**

$H^3(\alpha,\gamma)Li^7$  AND  $He^3(\alpha,\gamma)Be^7$  REACTIONS. H. D. Holmgren and R. L. Johnston (Naval Research Lab., Washington, D. C.). Phys. Rev. **113**, 1556-9 (1959) Mar. 15.

The cross sections for the  $H^3(\alpha,\gamma)Li^7$  and  $He^3(\alpha,\gamma)Be^7$  reactions were measured at bombarding energies of 480, 720, 940, 1130, and 1320 kev. The cross sections at the lower bombarding energies may be fitted within the experimental uncertainties by the expressions  $\sigma = 0.12(1 - 0.00051E_\alpha)E_\alpha^{-1} \exp(-125E_\alpha^{-1/2})$  b for the  $H^3$  reaction and  $\sigma = 2.8(1 - 0.00055E_\alpha)E_\alpha^{-1} \exp(-250E_\alpha^{-1/2})$  b for the  $He^3$  reaction, with  $E_\alpha$  in kev. (auth)

**14803**

ANALYSIS OF THE REACTION  $C^{13}(He^3,\alpha)C^{12}$ . George E. Owen, L. Madansky, and Steve Edwards, Jr. (Johns Hopkins Univ., Baltimore). Phys. Rev. **113**, 1575-80 (1959) Mar. 15.

The angular distributions of the alpha particles from the reaction  $C^{13}(He^3,\alpha)C^{12}$  at 4.5 and 2.0 Mev were analyzed from the point of view of nuclear stripping. By symmetrizing the wave function of the complete Hamiltonian with respect to the exchange of alpha particles, the heavy-particle stripping amplitude is formally included. The experimental distributions change decidedly between 2.0 and 4.5 Mev, and the calculated curves employing a combination of pickup and  $\alpha$ -stripping from  $C^{13}$  agree quite well with the experimental distributions. Interference between the two channels plays a major role in the final expressions. (auth)

**14804**

RADIATIONS FROM  $Tb^{156}$ . J. T. Holloway and L. Jackson Laslett (Iowa State Coll., Ames). Phys. Rev. **113**, 1581-3 (1959) Mar. 15.

The decay of  $Tb^{156}$  was studied following its production by the  $Tb^{159}(\gamma,3n)Tb^{156}$  reaction with 64-Mev bremsstrahlung. In the 5.6-day activity, 18 gamma transitions were detected with energies between 89 kev and 2060 kev. The K x-radiation of Gd was associated with this activity, while no Dy radiation was found. No annihilation radiation was detected. The gamma spectrum was observed in coincidence with the Gd x-ray and found to be closely similar to that observed alone. No evidence of  $\beta$ -decay was found and it is concluded that the observed decay is by orbital electron capture. A relatively weak 5.5-hr activity, ascribable to  $Tb^{156m}$ , was also produced by the  $(\gamma,3n)$  reaction. (auth)

## 14805

HIGHER ORDER CORRECTIONS TO THE ALLOWED BETA DECAY. Masato Morita (Columbia Univ., New York). *Phys. Rev.* **113**, 1584-9(1959) Mar. 15.

The shape of the allowed beta spectrum and the directional correlations of the allowed beta ray and gamma or alpha ray were investigated theoretically with an assumption of VA. The Coulomb field due to the daughter nucleus, the finite de Broglie wavelength effect, and the contribution of the second forbidden matrix elements,  $M(r^2)$ ,  $M(\alpha \cdot r)$ ,  $M(\sigma^2)$ ,  $M((\sigma \cdot r)r)$ ,  $M(\gamma_5 r)$ , and  $M(\alpha \times r)$ , simultaneously is taken into account. Relations between coordinate-type and momentum-type matrix elements are given in the nonrelativistic approximation. In this case,  $M(\alpha \times r)/M(\sigma) = M^{-1}$ . The correction factors for the beta spectra of  $B^{12}$  and  $N^{12}$  as well as their ratio have almost no energy dependence, since several corrections cancel each other. On the other hand, this ratio varies by 12% over the whole spectrum, if  $M(\alpha \times r)/M(\sigma) = M^{-1}(\mu_p - \mu_n)$  as given by Gell-Mann is adopted. The beta-alpha directional correlation of  $Li^8$  is discussed also. (auth)

## 14806

RATIO OF ASYMMETRIC TO SYMMETRIC FISSION OF  $U^{233}$  AS A FUNCTION OF NEUTRON ENERGY. R. B. Regier, W. H. Burgus, and R. L. Tromp (Phillips Petroleum Co., Idaho Falls, Idaho). *Phys. Rev.* **113**, 1589-92(1959) Mar. 15.

Radiochemical measurements of the relative yields of the fission products  $Mo^{99}$ ,  $Ag^{111}$ ,  $Ag^{113}$ , and  $Cd^{115}$  from the low-energy neutron-induced fission of  $U^{233}$  were made at various neutron energies. The energies chosen were thermal, 1.8, 2.3, and 4.7 ev, the latter three corresponding to the peaks of previously reported resonances. It was found that the ratio of asymmetric to symmetric fission is larger at the 1.8- and 2.3-ev resonances than at thermal energies. At the 4.7-ev resonance however, this ratio is the same as at thermal energy, to within experimental uncertainties. In addition, it was found that the ratio for epi-cadmium neutrons differed from that for thermal neutrons. The results are consistent with Wheeler's prediction that the ratio of asymmetric to symmetric fission should depend upon the spin state of the fissioning nucleus. (auth)

## 14807

ALPHA-DECAY BARRIER PENETRABILITIES WITH AN EXPONENTIAL NUCLEAR POTENTIAL; EVEN-EVEN NUCLEI. John O. Rasmussen (Univ. of California, Berkeley). *Phys. Rev.* **113**, 1593-8(1959) Mar. 15.

The real potential derived by optical-model analysis of data on elastic scattering of alpha particles is used for calculation of barrier penetrabilities for all known alpha decay groups of even-even nuclei. The barrier penetration factors were calculated by numerical integration in the WKB approximation taking into account centrifugal barrier effects, but ignoring noncentral interactions. Using these penetration factors and the experimental alpha half-lives, the reduced level widths  $\delta^2$  are calculated. Ratios of  $\delta^2$  values for ground and excited-state alpha groups are tabulated as a set of reduced hindrance factors. (auth)

## 14808

NUCLEAR MAGNETIC RESONANCE DETERMINATION OF ACTIVATION VOLUME FOR DIFFUSION IN LITHIUM. R. G. Barnes, R. D. Engardt, and R. A. Huftsch

(Iowa State Coll., Ames). *Phys. Rev. Letters* **2**, 202-4 (1959) Mar. 1.

Attention is directed to the fact that the activation volume for self-diffusion in solids can be measured by conventional nuclear magnetic resonance techniques. The line width  $\delta_\nu$  of the  $Li^7$  resonance in lithium metal dispersed in mineral oil was measured as a function of pressure to approximately 3000 atm. at several temperatures. The line width is quite strongly pressure dependent, roughly doubling at 3000 atm., and within this pressure range  $\ln \delta_\nu$  is a linear function of the pressure. (W.D.M.)

## 14809

MONOENERGETIC POSITRONS IN THE DECAY OF  $Bi^{206}$ . J. H. Brunner, H. J. Leisi, C. F. Perdrisat, and P. Scherrer (Federal Inst. of Tech., Zurich). *Phys. Rev. Letters* **2**, 207-9(1959) Mar. 1.

After K capture a vacancy exists in the K-shell. An electron-positron pair can be created, the electron captured in the K-shell, and only the positron emitted. To search for this effect, the electron capture decay of  $Bi^{206}$  into the 3.403-Mev level of  $Pb^{206}$  was examined. By measuring the positron spectrum with a lens spectrometer, a positron line was found which was interpreted as the monoenergetic positrons from the 1.72-Mev transition. (W.D.M.)

## 14810

NONMESONIC/MESONIC DECAY RATIO OF HELIUM HYPERFRAGMENTS. Peter E. Schlein (Northwestern Univ., Evanston, Ill.). *Phys. Rev. Letters* **2**, 220-3 (1959) Mar. 1.

An emulsion experiment is described in which 33 examples of nonmesonic decay of He were obtained. The events were produced in  $K^-$ -capture stars, had ranges  $\geq 59 \mu$ , and decayed with the formation of two visible prongs. Results of profile measurements made on known charge 1 and 2 tracks are shown. (W.D.M.)

## 14811

GAMMA-RAY ACTIVATION OF CARBON. L. D. Cohen and W. E. Stephens (Univ. of Pennsylvania, Philadelphia). *Phys. Rev. Letters* **2**, 263-4(1959) Mar. 15.

The direct photoactivation of carbon by the  $C^{12}(\gamma, n)C^{11}$  reaction was measured in the photon energy range 20.2 to 21 Mev. The carbon was reactor grade graphite in the form of an annular ring surrounding a tritium target. After a 40-minute irradiation at a given photon energy the carbon was inserted in a positron detector and counted for 20 minutes. The results are graphically shown and are in agreement with total absorption measurements. (A.C.)

## 14812

OBSERVATION OF CHARGED-PARTICLE REACTION PRODUCTS. J. M. McKenzie and D. A. Bromley (Atomic Energy of Canada Ltd., Chalk River, Ont.). *Phys. Rev. Letters* **2**, 303-5(1959) Apr. 1.

The results of a number of new measurements on the physical characteristics of Au-Ge junctions are summarized. These measurements demonstrate the potential usefulness of junction detectors in heavy-particle nuclear spectroscopy. The junction response to protons,  $He^3$  ions, and  $He^4$  ions as a function of the energy of the incident particle is graphically shown. (A.C.)

## 14813

NUCLEAR MAGNETIC MOMENT AND SPIN OF EUROPIUM-152m. V. W. Cohen and J. Schwartz (Brookhaven National Lab., Upton, N. Y.); and R. Novick (Univ. of



Illinois, Urbana). Phys. Rev. Letters 2, 305-7 (1959) Apr. 1.

The helicity of the neutrino was determined by studying the decay of the 9.3-hour isomeric state of  $\text{Eu}^{152}$ . The conclusions rest, in part, upon a knowledge of the spin and parity of this state. The result of the investigation indicates that the spin of  $\text{Eu}^{152}$  is zero. (A.C.)

#### 14814

EVIDENCE CONCERNING THE SPIN AND PARITY OF  $\text{Eu}^{152m}$ . L. Grodzins and A. W. Sunyar (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters 2, 307-9 (1959) Apr. 1.

Because of the importance of the neutrino helicity experiment performed by Goldhaber, an effort was made to find more convincing evidence for the parity and spin of  $\text{Eu}^{152m}$  than was presented. Various groups pursuing different lines of research have found all experiments are in agreement with a spin-parity of  $0^-$ . (A.C.)

#### 14815

INELASTIC DEUTERON SCATTERING FROM  $\text{Cu}^{63}$  AND  $\text{Cu}^{65}$ . J. L. Yntema and B. Zeidman (Argonne National Lab., Lemont, Ill.). Phys. Rev. Letters 2, 309-10 (1959) Apr. 1.

In the investigation of the elastic scattering of deuterons by separated isotopes of nickel and copper, it was found that the spectra of  $\text{Cu}^{63}$  and  $\text{Cu}^{65}$  show a group in the neighborhood of 1.3 Mev. From a graph of relative intensity plotted against excitation energy it is apparent that the resolution is such that the levels in the copper isotopes could not be well resolved. It is clear both from location and width of the peak that it is due to more than one of the five levels around 1.3 Mev. (A.C.)

#### 14816

EFFECT OF NUCLEAR ELECTRIC DIPOLE MOMENTS ON NUCLEAR SPIN RELAXATION IN GASES. P. A. Franken and H. S. Boyne (Univ. of Michigan, Ann Arbor). Phys. Rev. Letters 2, 422-3 (1959) May 15.

It is demonstrated that the nuclear spin relaxation times of pure gases at high pressures can be very sensitive to nuclear electric dipole moments. The analysis for noble gases is described and applied to the experimental data available for  $\text{He}^3$  and  $\text{Xe}^{129}$ . (W.D.M.)

#### 14817

ASTRONOMICAL TESTS OF THE EXISTENCE OF  $\text{Li}^4$ . Hubert Reeves (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters 2, 423-4 (1959) May 15.

The possible existence of the isotope  $\text{Li}^4$  is discussed, and its important astrophysical implications are considered. If it is concluded that  $\text{Li}^4$  exists, it would lead to the stellar reactions  $\text{H}^1(\text{H}^1, e^+\nu)\text{H}^2(\text{H}^1, \gamma)\text{H}^3(\text{H}^1, \gamma)\text{Li}^4(e^+\nu)\text{He}^4$  because of the lower Coulomb barrier of the third step. As a consequence of these reactions a large flux of high energy neutrinos could be expected at the earth's surface ( $10^{11}$  neutrinos/cm<sup>2</sup> sec). The failure to detect such a flux at Savannah River constitutes a strong case against the existence of  $\text{Li}^4$ . (W.D.M.)

#### 14818

POSSIBLE EFFECTS OF NUCLEAR SHELL CLOSURES ON NEUTRON STRENGTH FUNCTIONS. A. M. Lane, J. E. Lynn, E. Melkonian, and E. R. Rae (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Rev. Letters 2, 424-5 (1959) May 15.

Theoretical curves obtained from complex potential models of low-energy (s-wave) neutron strength func-

tions against mass number are plotted. The theoretical curve fits the observed values fairly well for most A, but there is pronounced disagreement in the region  $90 < A < 130$  where the curve is too high by up to an order of magnitude. It is pointed out that the disagreement may be due to fluctuations in both the size and shape of the imaginary part of the potential when N and Z are near the magic number 50. (W.D.M.)

#### 14819

$\pi^-/\pi^+$  RATIO FROM DEUTERIUM IN PHOTOPRODUCTION AT 500-1000 Mev. G. Neugebauer, W. D. Wales, and R. L. Walker (California Inst. of Tech., Pasadena). Phys. Rev. Letters 2, 429-30 (1959) May 15.

Preliminary results on the ratio of charged pions photoproduced from deuterium are presented. The pions were detected by the wedge-shaped magnet and associated counter system at laboratory angles and momenta corresponding to photoproduction from free nucleons by photons of 500, 600, 700, 800, 900, and 1000 Mev and center-of-momentum angles of 20, 40, 60, 90, 120, 150, and 163°. (W.D.M.)

#### 14820

RESONANCE OF  $\text{F}^{18}$  FROM DEUTERON BOMBARDMENT OF  $\text{O}^{16}$ . G. López, F. Alba, M. Mazari, and M. E. Ortiz (Universidad Nacional Autónoma, Mexico). Rev. mex. fis. 8, 17-25 (1959). (In Spanish)

Important differences from results predicted by the Butler theory were observed in angular distributions of the  $\text{O}^{16}(\text{d}, \text{p})\text{O}^{17}$  reaction, specially when the incident deuteron energy is near 1.7 Mev. In this neighborhood, the formation of the compound nucleus  $\text{F}^{18}$  from the fission of  $\text{O}^{16}$  and  $\text{H}^2$  is possible. To determine the position of this resonance, three series of exposures were carried out, measuring the intensity of proton groups with a known solid angle observed in a spectrograph as a function of the bombarding energy. The deflector and spectrograph magnetic fields were chosen so that the first excited state of  $\text{O}^{17}$  remained on the same plate position in the whole series of exposures and that the ground state of  $\text{O}^{17}$  and the elastic groups of  $\text{C}^{12}$  and  $\text{O}^{16}$  were registered simultaneously. A constant number of elastic deuterons of  $\text{O}^{16}$  was taken as reference, and the other intensities were corrected accordingly. A  $\text{F}^{18}$  resonance is established at a  $1.65 \pm 0.03$  Mev bombarding energy which corresponds to a level of  $\text{F}^{18}$  at 8.99 Mev. This also confirms with somewhat better approximation the result reported previously at 9.0 Mev. (auth)

#### 14821

MEASUREMENT OF NUCLEAR ISOMERIC HALF-LIVES IN THE RANGE FROM ONE MICROSECOND TO TEN MILLISECONDS. I. E. Lindstrom and Bernd Crasemann (Univ. of Oregon, Eugene). Rev. Sci. Instr. 30, 363-6 (1959) May.

Relatively simple and accurate delayed-coincidence apparatus for the measurement of isomeric half-lives in the millisecond range is described. Practical aspects of the statistics of delayed-coincidence counting are discussed. Half-life measurements of  $\text{Ta}^{181m}$  ( $17.83 \pm 0.10$   $\mu\text{sec}$ ) and  $\text{Y}^{88m}$  ( $300.5 \pm 5.0$   $\mu\text{sec}$ ) are described. (auth)

#### 14822

HALF-LIFE OF SULFUR-35. Raymond D. Cooper and Eugene S. Cotton (Quartermaster Research and Engineering Command, U. S. Army, Natick, Mass.). Science 129, 1360-1 (1959) May 15.

A new determination has been made of the half life of the beta emitter sulfur-35. Approximately 400 measure-

ments were taken over a period of a year and a half. These data were corrected for the dead time of the counter and then treated statistically. The half life was found to be  $86.35 \pm 0.17$  days. (auth)

**14823**

DEUTERON INTERACTIONS WITH NUCLEI. A. G. Sitenko. *Uspekhi Fiz. Nauk* **67**, 377-444(1959) Mar. (In Russian)

Investigations were made of deuteron interactions at low and high energies, including the elastic scattering of deuterons, effects of the spatial structure and deuteron absorption on the elastic scattering, stripping reactions in direct interaction, interference between direct processes and processes forming complex nuclei; and inelastic deuteron scattering on nuclei followed by nuclear excitation and deuteron spallation. Also studied were the processes of Coulomb interaction, the Coulomb spallation of deuterons, and the reaction (d,p) on heavy nuclei. In addition, studies were made of deuteron interactions with nuclei at high energies with special attention to deuteron spallation in electromagnetic fields of nuclei and production of deuterons in fast nucleon collisions with nuclei. (R.V.J.)

**14824**

MILLISECOND HALF-PERIOD ISOMERS PRODUCED IN REACTIONS INVOLVING 14 Mev NEUTRONS. V. L. Glagolev, O. M. Kovizhykh, Yu. V. Makarov, and P. A. Yampolskii. *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1046-57 (1959) Apr. (In Russian)

The short-lived  $\gamma$  radiation produced by pulsed irradiation of a number of elements with 14.5-Mev neutrons was investigated. Some 43 elements were irradiated. Nine isomer activities with half-periods ranging from  $10^{-3}$  to  $10^{-1}$  sec were detected in Mg, Al, Ge, As, Y, In, Pb, and Bi. The half lives and  $\gamma$ -ray energies were measured, and in some cases the isomer production cross sections were estimated. Besides the  $Pb^{207m}$  and  $Bi^{208m}$  activities all other isomer activities were produced in the neutron reactions for the first time. As a result it was possible to identify a number of the isomers and to discuss the possible decay schemes. (auth)

**14825**

NUCLEAR FORCES AND LEVELS OF THE LITHIUM ISOTOPES. V. V. Balashov (Moscow State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1123-8(1959) Apr. (In Russian)

A refinement is introduced in the intermediate coupling model of the nuclear shell theory by taking into account spin-orbit interaction between nucleons. Calculations carried out for  $Li^6$  and  $Li^7$  yield better agreement with the experiments than the usual intermediate coupling model which takes into account only single particle spin-orbit interactions. Some indications are obtained with respect to the existence of different types of radial dependence of nuclear forces of various exchange nature. (auth)

**14826**

ON RADIATIVE TRANSITIONS BETWEEN ROTATIONAL LEVELS IN SPIN  $\frac{1}{2}$  NUCLEI. D. F. Zaretskii. *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1129-32(1959) Apr. (In Russian)

The relative intensities of electric and magnetic transitions between rotational levels in spin  $\frac{1}{2}$  nuclei are considered. The calculation is carried out for the coupling scheme previously proposed by the author. As an example the  $Tm^{169}$  nucleus is considered. It is shown that the observed intensity ratio does not contradict the proposed coupling scheme. (auth)

**14827**

CONTRIBUTION TO THE THEORY OF DIRECT NUCLEAR REACTIONS INVOLVING POLARIZED PARTICLES. G. L. Vysotskii and A. G. Sitenko (Khar'kov State Univ.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1143-53 (1959) Apr. (In Russian)

The theory of direct nuclear reactions (stripping reaction and deuteron formation) involving polarized particles is considered. The angular distributions and polarizations of the products of direct nuclear reactions induced by polarized particles in oriented nuclei are determined by the perturbed wave method without account of spin-orbit coupling. (auth)

**14828**

ON THE PROPERTIES OF ELEMENTARY EXCITATION SPECTRUM NEAR THE DISINTEGRATION THRESHOLD ON THE EXCITATIONS. L. P. Pitaevskii (Inst. of Problems in Physics, Academy of Sciences, USSR). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1168-78(1959) Apr. (In Russian)

The singularity of the Bose fluid Green's function near the excitation disintegration threshold is investigated by quantum field theory methods without assuming weakness of the interaction. Three possible types of decay thresholds are shown. In the first case the excitation velocity at the threshold point  $p = p_c$  equals that of sound; thus starting from this point the excitation can produce phonons which results in damping proportional to  $(p_c - p)^3$ . In two other cases excitation in the threshold point can break up into two excitations with nonzero momenta which are either parallel to each other or form a definite angle. In both cases the spectrum curve ends at the threshold point, and the excitation velocity at this point is equal to that of each of the excitations produced in the decay. Scattering of neutrons in the liquid involving the production of excitations near the threshold is considered. (auth)

**14829**

EXCITATION OF ROTATIONAL NUCLEAR LEVELS BY CHARGED PARTICLES. A. D. Piliya (Leningrad Inst. of Physics and Tech., Academy of Sciences, USSR). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1185-91(1959) Apr. (In Russian)

Scattering of charged particles by nuclei with large quadrupole moments is considered in the adiabatic approximation. (auth)

**14830**

TRACKS OF HYDROGEN  $\mu$  MESOATOMS IN HYDROGEN CHAMBERS. S. S. Gershtein (Leningrad Inst. of Physics and Tech.). *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1309-11 (1959) Apr. (In Russian)

An analysis was made of  $\mu$ -mesoatom capture in hydrogen and hydrogen-deuterium systems. (R.V.J.)

**14831**

BETA INTERACTION AND NUCLEON FORM FACTOR. V. B. Berestetskii and I. Ya. Pomeranchuk. *Zhur. Eksptl'. i Teoret. Fiz.* **36**, 1321-2(1959) Apr. (In Russian)

Strong beta interactions induce nucleon form factors which can alter the  $\beta$  process dependence on energy. Investigations were made of the high-energy  $\beta$  conversions (conversion of electron into neutrino,  $e + p \rightarrow n + \nu$ ) which can be used for measuring the form factors. (R.V.J.)

**14832**

1959 NUCLEAR DATA TABLES. K. Way, ed. Washington, D. C., U. S. Atomic Energy Commission, 1959. 159p. \$1.00(GPO).



Nuclear information is presented which has been systematized according to some nuclear property, such as isotopic abundance, or some special topic such as neutron strength function. Ten tables are included which are self sufficient; explanations of abbreviations used and policies followed in each compilation are given at the beginning, and all relevant references at the end of that compilation. (J.R.D.)

**14833**

RADIATIONS FROM RADIOACTIVE ATOMS IN FREQUENT USE. L. Slack and K. Way. Washington, D. C., U. S. Atomic Energy Commission, 1959. 86p. \$0.55 (GPO).

A compilation of information on the radiations from radioactive atoms in common use, designed especially for workers in the biological and medical sciences who are concerned with dose estimates, is presented. The information is presented in tables and graphs. Also included for general orientation purposes are values of the electron ranges in water, as well as water and lead half-thicknesses for x rays emitted by each radioactive species listed. (J.R.D.)

**Theory****14834**

JOST FUNCTIONS AND DISPERSION RELATIONS. J. J. Giambiagi and T. W. B. Kibble (California Inst. of Tech., Pasadena). Ann. Phys. (N. Y.) **7**, 39-51 (1959) May.

The functions discussed were introduced by Jost in connection with the solution of the nonrelativistic Schrödinger equation. They are identical with the complex determinantal function, discussed by Baker and extended to field theory. Their properties are summarized and discussed, and some applications are described. It is argued that if some additional relation were obtained, which made it possible to solve the dispersion relations for them, this formalism might have distinct advantages over that in terms of dispersion relations for the scattering amplitude. In particular, the difficulties associated with the Castillejo-Dalitz-Dyson ambiguity would no longer appear. Moreover, it is suggested that there may be a useful application to the correct description of bound states in scattering theory. (auth)

**14835**

NUCLEON SPECTRUM IN STRONG COUPLING THEORY. L. F. Landovitz (Brookhaven National Lab., Upton, N. Y.) and B. Margolis (Columbia Univ., New York). Ann. Phys. (N. Y.) **7**, 52-64 (1959) May.

The energy levels of the nucleon in fixed source pseudoscalar theory are considered in the strong-coupling limit. In addition to the previously found levels with  $t = j$ , levels characterized by the integral quantum number  $y$ ,  $Y^2 = (T + J)^2$ , are found which are given by

$$E_{j,t}^{(y)} = \frac{1}{\kappa a} \sqrt{Aa^3 y(y+1)} \kappa + \frac{3j(j+1) + t(t+1) - \frac{3}{2}}{4} \frac{\kappa}{g^2/\kappa a},$$

$$E_{j,t}^{(y,n)} = \frac{1}{\kappa a} \sqrt{3Aa^3 [y(y+1) - \frac{3}{4}n^2]} \kappa + \frac{3j(j+1) + t(t+1) - \frac{3}{2}}{4} \frac{\kappa}{g^2/\kappa a},$$

$n \text{ even, } n^2 \leq y^2.$

The length  $a$  is a cutoff length of the order of the nucleon size. The quantity  $A$  is of the order of  $1/a^3$ . The  $\pi$  meson mass is given by  $\kappa$  and  $g$  is the meson-nucleon coupling constant. (auth)

**14836**

PROTON-PROTON SCATTERING WITH PARITY AND TIME-REVERSAL NONINVARIANCE. A. E. Woodruff (Univ. of Rochester, N. Y.). Ann. Phys. (N. Y.) **7**, 65-83 (1959) May.

A formalism is developed to treat some of the effects of a hypothetical breakdown of parity and time-reversal invariance in the proton-proton interaction. It is shown how the usual parametrization of the S-matrix (in terms of phase shifts and mixing parameters) must be extended to include a description of such violations. Some of the experiments which could detect these violations, if they existed, are discussed, and the general form of the p-p potential is extended. An appendix applies the formalism to two experiments testing time-reversal invariance. (auth)

**14837**

RADIATION OF AN ELECTRON IN AN INFINITELY LONG WAVEGUIDE. H. Motz and M. Nakamura (Oxford Univ.). Ann. Phys. (N. Y.) **7**, 84-131 (1959) May.

A treatment is given of the electromagnetic fields excited by a single electron with prescribed motion in an infinitely long cylindrical space surrounded by perfectly conducting walls, and filled with a uniform linear medium. The medium is assumed to be lossy in order to avoid complexities arising from the radiation condition. The problem is attacked by first obtaining a general expression for the electric Hertz vector. From this Hertz vector the electric fields are calculated for (1) uniform motion of the electron parallel to the axis of a waveguide of arbitrary cross section (2) uniform but longitudinally oscillatory motion and (3) undulating motion with constant velocity parallel to the axis of a rectangular wave-guide. It is found that the electric field can be represented as the sum of residues corresponding to different field patterns. The power flow from the electron to the electromagnetic field is calculated. Cherenkov and undulator radiation are not the only causes of energy loss. In the presence of a dielectric medium power also flows into "electrostatic oscillations." Expressions for the energy loss of an electron similar to those previously given by Bohm and Pines and by Fermi are obtained by our method. It is shown that an upper limit exists for the energy loss including Cherenkov and "electrostatic" loss. No such upper limit can be given in the case of undulator radiation. This is shown to be connected with the fact that the latter radiation is propagated both forward and backward. In the limit of infinitely large cross section of the waveguide the formulae tend to the results for the unbounded medium. This shows that the influence of the walls is correctly calculated. (auth)

**14838**

A SPHERICAL WAVE EXPANSION FOR DOUBLE  $\beta$ -DECAY. S. P. Rosen (Washington Univ., St. Louis). Can. J. Phys. **37**, 780-5 (1959) June.

It was recently shown that spherical wave solutions of the Dirac equation for a central field and the properties of angular momentum coupling coefficients could be used to derive a general formulation of the theory of  $\beta$ -decay transitions of arbitrary forbiddenness. Here it is shown how the theory of double  $\beta$  decay is similarly formulated. (T.R.H.)

## 14839

CLASSICAL AND QUANTAL FLUX IN THE OPTICAL MODEL. R. M. Eisberg, I. C. McCarthy, and R. A. Spurrier (Univ. of Minnesota, Minneapolis). Nuclear Phys. **10**, 571-82(1959) Apr. (2).

In a semi-classical theory, direct interactions are described by two-body collisions at points in the nucleus. To describe the initial conditions for the collision, the momentum of the incident particle, the probability of finding it at the collision point, and the probability of a collision occurring must be known. These were calculated first by describing the particles by classical rays which can be refracted and absorbed by an optical potential. In the process of making these calculations it was found that the transmission coefficients for a particle following a given ray through the nucleus were not always in agreement with transmission coefficients calculated by quantum mechanics for the corresponding partial wave. To investigate this point the average flux and its divergence were calculated from the classical ray picture. The values of these quantities were found to be close to those of corresponding quantities calculated by quantum mechanics in the same potential where they are significantly large, but large differences were found where the flux and divergence are small. The conclusion is reached that the probability of a particle appearing at a point in the nucleus is, in general, not uniquely connected with the corresponding probability of finding it at a point outside, as is implied by a ray calculation. That is, the disturbance at any interior point is influenced by several partial waves. However, a classical flux calculation is sufficiently accurate to be useful in certain applications. (auth)

## 14840

FLUX OF PARTICLES IN THE OPTICAL MODEL. Ian E. McCarthy (Univ. of Minnesota, Minneapolis). Nuclear Phys. **10**, 583-9(1959) Apr. (2).

The flux of 18 Mev  $\alpha$  particles in argon is calculated with two optical model potentials which give similar elastic scattering and reaction cross sections. Although these potentials are similar in the nuclear surface, they give different fluxes inside the potential and in particular different values for the divergence of the flux which represents the probability of absorption of the beam at a point. The divergence for  $\alpha$ -particles in both potentials is peaked more strongly at the surface than that for protons of the same momentum in a realistic potential, but it is not negligible in the center. The divergence peaks are of different heights in the two potentials and hence may give different total cross sections for direct interactions. (auth)

## 14841

NUCLEON CLUSTERS IN THE NUCLEAR SURFACE. D. H. Wilkinson (Clarendon Lab., Oxford). Phil. Mag. (8) **4**, 215-18(1959) Feb.

The absorption of slow  $K^-$  mesons by complex nuclei frequently results in the emission of fast  $\Sigma^+$ -hyperons unaccompanied by  $\pi$  mesons. This observation is combined with the argument of Jones that such absorption is a surface phenomenon to suggest that the nuclear surface is rich in nucleon clusters, possibly alpha particles. (auth)

## 14842

A SOLUBLE PROBLEM IN DISPERSION THEORY. M. L. Goldberger and S. B. Treiman (Princeton Univ., N. J.). Phys. Rev. **113**, 1663-9(1959) Mar. 15.

The Lee model is modified by addition of a new field  $\theta'$  and a weak coupling  $N + \theta \rightarrow N + \theta'$ , which leads to instability of the  $V$  particle:  $V \rightarrow N + \theta \rightarrow N + \theta'$ . The decay amplitude is calculated to lowest order in the weak coupling by dispersion relation methods. In effect, a study of a set of simultaneous dispersion relations is required. The problem is completely soluble and serves to clarify the essential structure of dispersion methods. The results agree with what one obtains, more easily in the present case, by direct methods. (auth)

## 14843

NATURE OF THE VECTOR INTERACTION IN  $\mu^-$ -ABSORPTION. Steven Weinberg (Columbia Univ., New York). Phys. Rev. Letters **2**, 223-4(1959) Mar. 1.

Feynman and Gell-Mann have suggested that the strangeness-conserving vector lepton interaction current is conserved and equal to the isovector part of the electromagnetic current. It is suggested that a comparison of the rate of any  $0 \rightarrow 0$  (no)  $\mu^-$  capture with the cross section for the corresponding inelastic electron scattering process may serve as a definitive test of the Feynman-Gell-Mann proposal. (W.D.M.)

## 14844

EQUIVALENCE TRANSFORMATION OF THE  $\beta$  DECAY OPERATOR. G. Barton (Clarendon Lab., Oxford). Phys. Rev. Letters **2**, 224-6(1959) Mar. 1.

There have been attempts recently to use the Chew-Low fixed source theory with cutoff for calculating mesonic corrections of the  $\beta$  decay and magnetic moment of the nucleon. Since the nucleons one deals with in Chew-Low theory are described not by  $\psi$  but by  $\psi'$ , it follows that the operators coupling nucleons to other fields must be transformed. The mesonic corrections to the axial vector  $\beta$ -decay operator are considered. (W.D.M.)

## 14845

EVIDENCE FOR RESONANCE STATES IN THE  $K^-$ -N SYSTEM. P. T. Matthews and Abdus Salam (Imperial Coll., London). Phys. Rev. Letters **2**, 226-7(1959) Mar. 1.

The high value of the  $K^-$ -p elastic cross section compared with the  $K^+$ -p cross section, the suspicion that the  $K^-$ -p potential is attractive and the  $K^+$ -p repulsive, and a characteristic peaking of the  $K^-$ -p cross section around  $T_k$  (lab) = 25 Mev seem to suggest the possibility that interactions in the energy range 15 to 60 Mev proceed mainly through a  $J = \frac{1}{2}$  resonance centered around  $T_k = 25$  Mev. (W.D.M.)

## 14846

CORRECTIONS TO THE 3D-2P TRANSITIONS IN  $\mu$ -MESONIC PHOSPHORUS AND THE MASS OF THE MUON. A. Petermann and Y. Yamaguchi (CERN, Geneva). Phys. Rev. Letters **2**, 359-61(1959) Apr. 15.

Owing to the real importance of having the most precise value of the lower limit of the muon mass, a very careful examination of the corrections in order to reduce considerably the limit of error is described. A summary of the corrections considered is listed. (W.D.M.)

## 14847

LOW-ENERGY APPLICATION OF RELATIVISTIC K-MESON-NUCLEON DISPERSION RELATIONS. P. K. Roy (Imperial Coll., London). Phys. Rev. Letters **2**, 364-5(1959) Apr. 15.

On the assumption that the K meson is pseudoscalar the approach of Chew et al. has been extended to K-



meson-nucleon scattering to find out whether the dispersion equations are compatible with the assumption of any resonance in the P states. It is concluded from an analysis of K particles that the dispersion relations give no grounds to expect any resonance in the P states in spite of the similar space properties of  $\pi$  and K mesons. (W.D.M.)

**14848**

EFFECT OF A PION-PION SCATTERING RESONANCE ON NUCLEON STRUCTURE. William R. Frazer and Jose R. Fulco (Univ. of California, Berkeley). Phys. Rev. Letters 2, 365-8(1959) Apr. 15.

The electromagnetic properties of the nucleon have recently been studied by the dispersion-relation method. Although qualitatively successful in accounting for the isotopic vector properties of the nucleon, these treatments proved incapable of explaining simultaneously the value of the magnetic moment and the radii of the charge and moment distributions. It is shown that the inclusion of a strong pion-pion interaction could explain these aspects of nucleon structure. (W.D.M.)

**14849**

POSSIBLE DETERMINATION OF HYPERON PARITIES AND COUPLING STRENGTHS. Saul Barshay and Sheldon L. Glashow (Univ. of Copenhagen). Phys. Rev. Letters 2, 371-3(1959) Apr. 15.

An experiment for determining the relative  $\Sigma$ - $\Lambda$  parity is discussed which appears to be feasible at this time. An examination of the 400-Mev neutron-proton angular distribution in the backward directions has yielded a new evaluation of the pion-nucleon coupling constant. An analogous procedure applied to the hyperon-nucleon data is suggested concerning such processes as:  $\Sigma^- + p \rightarrow \Lambda + n$  and  $\Sigma^- + p \rightarrow \Sigma^0 + n$ . (W.D.M.)

**14850**

MESON-THEORETICAL ORIGIN OF THE SPIN-ORBIT COUPLING BETWEEN TWO NUCLEONS. N. Tzozar, R. Raphael, and A. Klein (Univ. of Pennsylvania, Philadelphia). Phys. Rev. Letters 2, 433-4(1959) May 15.

It is generally agreed that the phenomenological analysis of p-p scattering data at high energies by means of a potential energy function suggests strongly the action of a spin-orbit force in triplet odd states. The situation with respect to the triplet even states is less conclusive, the existing evidence indicating that the spin-orbit coupling is at least weaker and perhaps appreciably weaker here. A conservative meson-theoretical approach is described which yields qualitative results in agreement with the above remarks. Though hardly definitive from a quantitative viewpoint, its essential elements should be contained in a more complete theory. (W.D.M.)

**14851**

PRECESSION OF THE POLARIZATION OF PARTICLES MOVING IN A HOMOGENEOUS ELECTROMAGNETIC FIELD. V. Bargmann (Princeton Univ., N. J.); Louis Michel (Collège de France, Paris); and V. L. Telegdi (Univ. of Chicago). Phys. Rev. Letters 2, 435-7(1959) May 15.

**14852**

MANY-CHANNEL UNITARITY CONDITION. Richard H. Capps (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters 2, 475-7(1959) June 1.

Many useful relations concerning particle reaction

problems are known to follow from the unitarity of the reaction matrix. Watson has shown that if there are only two channels open, the requirements of unitarity and time-reversal invariance imply that the phase of the inelastic amplitude is equal to the sum of the phase shifts for the two elastic processes. A useful generalization of this theorem to the case when many channels are open is derived and applied to the photoproduction of mesons at 600 Mev. (W.D.M.)

**14853**

THEORY OF THE PHOTODISINTEGRATION OF THE DEUTERON AND n-p CAPTURE. J. J. de Swart (Univ. of Rochester, N. Y.). Physica 25, 233-50(1959) Apr.

The photodisintegration of the deuteron and the n-p capture in the medium energy range is investigated by considering the final state interactions including tensor coupling exactly. The electric transitions are treated in all multipole orders, assuming the validity of the Siegert theorem. Of the magnetic transitions, only the magnetic dipole spin flip transition is taken into account. For the photodisintegration, the angular distribution and polarization of the outgoing nucleons are given for arbitrary polarized radiation. In the n-p capture, the angular distribution and polarization of the  $\gamma$ -rays are given for an arbitrarily polarized neutron beam. The formulas are specialized for E1, E2, and M1 spin flip transitions. (auth)

**14854**

GAMMA LINES IN THE DECAY OF  $Ti^{202}$ . P. Born, J. Molenaar, and J. Blok (Vrije Universiteit, Amsterdam). Physica 25, 326-32(1959) Apr.

The gamma-radiation of  $Ti^{202}$  was reinvestigated by means of a gamma-scintillation spectrometer. Two new gamma-lines were found viz. of 523 and 965 kev. An estimation was made for the transition-energy to the ground state of  $Hg^{202}$  and a level scheme of  $Hg^{202}$  was set up. The ratio of the energies of the second and first excited states was compared with the values of neighboring nuclei. (auth)

## RADIATION EFFECTS ON MATERIALS

**14855** AD-151752

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

INVESTIGATION OF THE STRUCTURE OF NEUTRON IRRADIATED LITHIUM FLUORIDE. Robert H. Bragg. [1957?]. 26p.

A program to investigate the structure of neutron irradiated lithium fluoride is described. It is shown that with suitable changes direct methods of analysis can be used to obtain precise quantitative information about the nature and extent of radiation induced structural changes in materials. This new approach is an extension of conventional methods to the unusual aperiodic structures produced by prolonged neutron irradiation. The results anticipated from this study will help to clarify the problems of predicting the performance of materials under irradiation. (auth)

**14856** AD-205290

Stanford Research Inst., Menlo Park, Calif. OBTAINING A SYSTEM OF DOSIMETRY. Progress Report No. 6 [for] July 28 to September 27, 1957. S. I. Taimuty. 12p. Project No. 7-84-01-002. Contract DA 19-129-QM-766.

The effects of radiation on the luminescence of aspirin (acetylsalicylic acid), bibenzyl, naphthalene, and biphenyl were investigated for possible application to dosimetry. Both aspirin and bibenzyl were found to give satisfactory response in the range  $2 \times 10^5$  to  $4 \times 10^6$  rads. Naphthalene was found to sublime so rapidly that its usefulness is questionable. Biphenyl degradation was too small to be useable in the range below  $10^7$  rads. Fading data on Gafite plastic material were obtained, and some preliminary irradiations of the nitrous oxide gas dosimeter were performed. Samples of Ozalid foil and four special samples of dye-coated Dupont cellophane were examined. These materials lacked sensitivity in the  $10^4$ - to  $10^7$ -rads range, except for one sample of cellophane, which was found to have a sensitivity equal to that of Dupont blue cellophane. Experiments were performed with two monitoring schemes for high energy electron beams. One scheme depends on the temperature rise produced by electrons incident on an array of wires. The other functions by virtue of the secondary electron emission from a thin metallic foil penetrated by high energy electrons. Preliminary performance data were obtained only for the second scheme. (auth)

#### 14857 AERE-M/R-1750

United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England.

#### THE BEHAVIOUR OF FISSILE MATERIAL UNDER IRRADIATION AT ELEVATED TEMPERATURES.

L. M. Wyatt. Sept. 1955. Decl. Apr. 30, 1959. 30p. Includes: APPENDIX I. THE EFFECT OF GAS IN SOLUTION IN THE URANIUM LATTICE. APPENDIX II. THE POSSIBLE VOLUME CHANGES IN URANIUM AT LOW TEMPERATURE. O. S. Plail and L. M. Wyatt. (FRDC/P-130; FRFEWP/P-58; RCTC/P-55).

A method of calculating the increase in volume of uranium metal on irradiation caused by the fission product gases is worked out. This accounts for the expansions observed at temperatures above  $700^\circ\text{C}$ . The observed behavior between  $450$  and  $660^\circ\text{C}$  is not explained by this mechanism, if the information on the determined creep strength of uranium is assumed in the calculation. Where these high expansions cannot be ascribed to surface effects due to very small sized specimens it is suggested that they result from cycling of the material through phase transformations on a macro scale (or micro in the fission zone). For irradiation resistance isotropy, high creep strength, and the absence of phase transitions over the working temperature range is required. (auth)

#### 14858 BMI-1336

Battelle Memorial Inst., Columbus, Ohio. DESCRIPTION OF A CAPSULE FOR IRRADIATION OF FUEL SPECIMENS AT HIGH TEMPERATURES. Sam J. Basham, John H. Stang, William H. Goldthwaite, and Bruce W. Dunnington. Apr. 22, 1959. 26p. Contract W-7405-eng-92. \$1,00(OTS).

A controlled-temperature irradiation capsule was operated containing small fueled specimens at  $1600$  to  $1650^\circ\text{F}$ . The design involved calculating the specimen heat-generation rate and designing an insulating gas gap around the specimens to achieve the desired temperature. Electric heaters were inserted to help control temperature. The thickness and composition of the gas gap were modified prior to operation on the basis of information on probable neutron flux obtained from a

nuclear mock-up, and on the basis of information on the thermal resistance of various gas annuli obtained from a thermal mock-up. The desired irradiation temperature of  $1625^\circ\text{F}$  was achieved with a variation of  $\pm 25^\circ\text{F}$ . (auth)

#### 14859 NP-7606

Naval Powder Factory, Indian Head, Md.

#### EFFECTS OF GAMMA RADIATION ON NITROCELLULOSE. Memorandum Report No. 128. Hyman Rosenwasser and C. L. Whitman. Jan. 28, 1957. 10p.

Samples from 2 lots of uncolloided nitrocellulose were subjected to total integrated doses of 1, 3, 5, 7, 9, and 11 million roentgens. Results of subsequent nitrogen determinations showed a slight decrease in nitrogen content as dosage increased. Bond rupture of the nitrocellulose is proposed as the major cause of the corresponding decrease in viscosity. (auth)

#### 14860 PA-TR-2489

Picatinny Arsenal. Samuel Feltman Ammunition Labs., Dover, N. J.

#### MECHANICALLY-INDUCED AND RADIATION-INDUCED DEFORMATION FAULTS IN SODIUM AZIDE. Saul Krasner and David T. Keating. May 1958. 45p. TA2-8065; DA Project No. 5A12-15-005.

Sodium azide crystals were subjected to mechanical force (grinding in a mortar and pestle), gamma irradiation, and reactor (pile) irradiation and were then examined by x-ray-diffraction techniques to determine whether any change in the crystalline structure had occurred. Stacking faults were introduced into the samples subjected to mechanical force (grinding), and more severe faulting was introduced into samples subjected to irradiation. Certain signs of decomposition—lowering of the ignition temperature, discoloration, and lattice contraction—were present in the samples which had been exposed to radiation. Annealing was found to remove some of the faults, both mechanically-induced and radiation-induced, but in both cases a significant fraction of the faults were stable, even at the ignition temperature. In addition to stacking faults, certain other causes of strain such as interstitials and vacancies, decomposed azide molecules, and interstitial nitrogen appear to be present. (auth)

#### 14861 WADC-TR-58-78

Wright Air Development Center. Materials Lab. Wright-Patterson AFB, Ohio.

#### THE EFFECTS OF GAMMA IRRADIATION ON ACRYLONITRILE-BUTADIENE COPOLYMERS. Period Covered: June 1956 to August 1957. John A. Parker, Freeman F. Bentley, E. A. Peterson, and Denver Hale. Feb. 24, 1958. 109p. Project No. 7360. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: IDENTIFICATION OF MOLECULAR AND MICROSTRUCTURES OF AIRCRAFT MATERIALS. (AD-155871; PB-151261. \$2.50(OTS).

Changes in the chemical and physical properties produced by the irradiation of a series of acrylonitrile-butadiene copolymers varying in composition from 20 to 50% acrylonitrile with gamma photons from a cobalt-60 source were measured and correlated with the nature of the copolymer, initial type of cure (sulfur, peroxide, or radiation), and the total integrated dose. This dose was converted to the energy equivalent in graphite units now being recommended for standardized dosage terminology. The efficiencies of these cross-linking processes induced by radiation were estimated from the molecular weights between cross-links,  $M$ , determined



by swelling volume measurements by a procedure similar to that used for natural rubber by Charlesby. The efficiencies of cross-linking determined in this way are a more realistic measure of the relative stabilities of these copolymers than a comparison of the complex physical properties. Nevertheless, reasonable agreement exists between cross-linking densities determined by swelling volume and those determined by modulus measurements. The very regular behavior of the change in cross-linking density as a function of the total amount of energy deposited in terms of equivalent in graphite suggests the use of such polymers in dosimeter applications. These relationships enable one to predict the energy equivalent per gram of graphite for compositions cured by either sulfur or peroxides, (auth)

#### 14862 WADC-TR-58-683

Stanford Research Inst., Menlo Park, Calif.

EFFECTS OF HIGH ENERGY, HIGH INTENSITY ELECTROMAGNETIC RADIATION ON ORGANIC LIQUIDS. [Period covered]: May 1, 1958 to October 31, 1958.

Robert M. Wagner and Leland H. Towle. Feb. 1, 1959. 43p. Project title: MATERIALS ANALYSIS AND EVALUATION TECHNIQUES. Task title: EFFECTS OF NUCLEAR RADIATION. Contract AF33(616)-3738. (AD-211915).

Practical nuclear power applications require organic materials which offer optimum resistance to undesirable effects of radiation. Hydraulic and lubricating fluids in nuclear power auxiliary equipment are cases in point. Some of these may of necessity be located in a high flux density radiation field. This study of several representatives of different types of organic structure was an attempt to provide background information which may suggest methods of judicious choice for efficient design of radiation-resistant equipment. The following compounds were subjected to high energy electron or gamma bombardment: aromatic amines, aromatic nitro compounds, alkyl aromatic ethers, alkyl aromatic hydrocarbons, and aliphatic esters. In addition, alkyl aromatic compounds and aliphatic esters were subjected to high energy neutron bombardment. (For preceding period see WADC-TR-58-206.) (auth)

#### 14863

REVERSIBLE RADIATION-MECHANICAL EFFECTS IN POLYMERS. M. A. Mokul'skii, Yu. S. Lazurkin, M. B. Fiveiskii, and V. I. Kozin. *Doklady Akad. Nauk S.S.S.R.* 125, 1007-10(1959) Apr. 11. (In Russian)

The mechanical properties of polymers during irradiation were studied with a powerful source from a nuclear reactor. The experiments were carried out in water-cooled vertical wells. The neutron flux,  $\gamma$  quanta, and the energy dose received by the specimens were measured. The latter was determined by the initial heating rate of dosimetric specimens prepared from identical materials. By varying the reactor power the dose was varied up to  $\sim 50,000$  r/sec. The reversible radiation-mechanical effects observed in polymers during irradiation were not observed after irradiation was stopped. The observed effects were expressed by a lowered polymethyl methacrylate stability, lower limits of induced elasticity, and expansion of ruptures in polyvinyl chloride, increased relaxation rates, and increased creep in polyvinyl chloride, polystyrene, teflon, and rubber. (R.V.J.)

#### 14864

MEASUREMENT OF LUMINESCENCE AND DARKENING

OF GLASS WHEN IRRADIATED IN A NUCLEAR REACTOR. G. Ya. Vasil'ev, A. F. Usaty, Yu. S. Lazurkin, and A. A. Markov. *Doklady Akad. Nauk S.S.S.R.* 125, 1219-22(1959) Apr. 21. (In Russian)

Descriptions are given of an installation for simultaneous measuring the luminescence and darkening of irradiated transparent materials in nuclear reactors as well as the uses of the installation for experimental purposes. Specimens of three type of quartz, pyrex, and cerium glass and polymethyl methacrylate and polystyrene were tested for the luminescence dependence on differential doses. Existence of the "differential" and "integral" darkening effects and the peculiar darkening kinetics of some types of quartz were assumed to be related to the various color centers capable of interactions and inter-transformations; however, these factors should be further investigated. (R.V.J.)

#### 14865

DIRECTIONAL DEPENDENCE OF THE SCINTILLATION LIGHT YIELD FROM ANTHRACENE CRYSTALS BOMBARDED WITH  $\alpha$  PARTICLES. Paul Henrich Heckmann (Universität, Göttingen, Ger.). *Naturwissenschaften* 46, 259-60(1959). (In German)

In an investigation of the scintillation light yield of anthracene crystals irradiated with alpha particles, it was established that the light intensity is strongly dependent on the incident direction of the alpha particle. The experimental arrangement to measure the directional dependence was described. The light yield was measured as a function of the angle between the incident direction of 5.3-Mev alpha particles and the normal to the ab plane of the crystal. A maximum was obtained at the perpendicular to the ab plane and the minimum was obtained at an angle of  $90^\circ$  (incident particle in direction of the a axis). The origin of directional dependence was discussed. (J.S.R.)

## RADIOACTIVE WASTE

#### 14866 AECU-4130

[Los Alamos Scientific Lab., N. Mex.]

RADIOACTIVE TRASH DISPOSAL AT LOS ALAMOS. John W. Enders. Sept. 15, 1958. 14p. Contract [W-7405-eng-36]. \$3.30 (ph), \$2.40 (mf) OTS.

Methods of solid radioactive waste disposal at Los Alamos are described. The principal contaminant is Pu. Because of the high toxicity of this element, it is disposed of by burial. The method is felt to be adequate for low-level alpha activity, but not for high-level beta-gamma radiation. (J.R.D.)

#### 14867 CRDC-841

Atomic Energy of Canada Ltd., Chalk River, Ont.

THE DURABILITY OF SOME SILICATE GLASSES THAT COULD BE USED IN FISSION PRODUCT DISPOSAL. R. W. Durham and D. Bell. Aug. 1958. 31p. (AECL-817). \$1.00(AECL).

The corrosion by water of glass made by fusing nepheline syenite with various fluxing agents has been investigated. The objective is to obtain a workable glass that would incorporate waste fission products and have a high resistance to attack by water. Glass of composition 15 wt. % CaO, 85 wt. % nepheline syenite, has been found to have a corrosion rate of  $2 \times 10^{-8}$  g glass/cm<sup>2</sup>-day at room temperature after the first few days of water contact. The effect of pH on the corrosion rate has

been investigated and also the selective leaching of cations of different valency. (auth)

**14868**

CONTROL OF RADIOACTIVE LIQUID WASTES IN PENNSYLVANIA. Karl M. Mason. Public Health Repts. U. S. 73, 895-7(1958) Oct.

Public health authorities in Pennsylvania are administering a program of radioactive liquid waste control in the following manner: (1) Radioactive liquid wastes have been classified as industrial wastes and thus are subject to a permit from the Sanitary Water Board. (2) Since the treatment processes employed at such installations have not been subject to full-scale operation experience, the permits are granted on an experimental basis. (3) For the purpose of insuring protection of the public health and the retention of stream volumes for future discharges, the levels of radioactivity in liquid wastes must conform to more stringent standards than those generally accepted. (4) The conditions of the permit, including the maximum allowable concentrations, are subject to revision if altered conditions or the advance of science and technology so indicate. (5) The discharge of radioactivity shall be kept at the most practicable minimum, regardless of maximum amounts permissible. (6) Adequate analyses and operational reports must be submitted to the department of health. (7) Environmental monitoring programs shall be continued and, if necessary, expanded. (8) Immediate notification of the department is required in the event of accident or discharge in excess of tolerance. (auth)

**14869**

THE SAFE DISPOSAL OF WASTE FROM ATOMIC ENERGY ESTABLISHMENTS. B. J. Lister. Roy. Soc. Promotion Health J. 78, 498-506(1958) Sept.-Oct.

The aims in disposal of radioactive wastes are, first, to ensure, irrespective of cost, that the limits set for maximum permissible levels of radiation to individuals and to the public are not exceeded, and second, having regard to cost, convenience, and the national importance of the application, to reduce the radiation doses below these levels. In general, there are only two methods of radioactive waste disposal—dispersion to the environment (to atmosphere, seas or rivers), or storage. Almost all forms may be employed, depending upon hazards and problems involved: disposal may be by dispersal to the atmosphere or to rivers in the case of low activity wastes; burial or packaging for disposal at sea in cases of high radiation level. Two new approaches appear promising: the possibility of chemical separation of constituents after reasonably short periods of storage (10–20 years), or fixing fission products in solid form, e.g., by absorbing in clay or incorporating in cement or ceramics. (T.C.O.)

## REACTORS

### General

**14870** ANL-5948

Argonne National Lab., Lemont, Ill.  
REACTOR CONTAINMENT (INCLUDING A TECHNICAL PROGRESS REVIEW). R. O. Brittan. May 1959. 261p. Contract W-31-109-eng-38. \$4.00 (OTS).

An attempt is made to present available information pertinent to reactor containment. This is done directly,

by summary and reference, or by reference alone. To provide a reference framework, the first review document must necessarily be handled differently from supplemental periodic reviews. The plan is to: (1) provide a detailed account of the problem and suggestions for work needed to yield adequate solutions; (2) present the accumulated knowledge and accomplishments; (3) give an account of experience in applying the containment concept; and (4) append extensive bibliographical material. An attempt is made in each case to indicate the significance of the information and its relation to the problems outlined. (A.C.)

**14871** ANL-6008

Argonne National Lab., Lemont, Ill.  
CONTROL ASPECTS OF VERY HIGH FLUX RESEARCH REACTORS (thesis). Antonio C. Didier B. Vianna. May 1959. 105p. Contract W-31-109-eng-38. \$2.50 (OTS).

Submitted to Rensselaer Polytechnic Inst.

The computation of reactor characteristics over a fuel cycle in a way suitable to the investigation of the control aspects of the reactor problem is considered. The dynamic problem including as independent variables the neutron energy, the space, and time was studied. An additional condition of versatility in the method used to obtain the solutions is necessary to explore the control aspects of the problem. The normal possibilities of the analog computers were surveyed, and a method was found to solve the reactor dynamic problem. The classical approach of considering the neutron energy dependency in groups and the spatial dependency in reactor regions is used. Only cases of regular symmetry are considered, so that the reactor three dimensional configuration is reduced by analytical methods to the study involving one space coordinate. Time is considered as a continuous variable. The Mighty Mouse Reactor is simulated, and the analog results are compared against published data. With the spatial dependency represented by three core and three reflector regions, the fast and slow flux distributions are within 5% of the digital computer solution of the same problem. At the end of the fuel cycle, the flux distribution is essentially that of the digital solution with the values lowered 5 to 10%. Compared with hand numerical computations made considering the same number of core regions, the analog results show agreement within 1%. Some fundamental aspects of the long term reactor dynamics are discussed, based on results from the simulator. Illustrative examples of power transients, shut-down, control by burnable poison and localized control rods are included and discussed. (auth)

**14872** BRL-1067

Ballistic Research Labs., Aberdeen Proving Ground, Md.

THE ELASTIC RESPONSE TO INTERNAL BLAST LOADING OF MODELS OF OUTER CONTAINMENT STRUCTURES FOR NUCLEAR REACTORS. J. W. Hanna, W. O. Ewing, Jr., and W. E. Baker. 51p. Sponsored by AEC under DA Project No. 503-04-002. \$1.75 (OTS).

Results of an experimental study of the elastic response of four geometrically scaled models of nuclear reactor outer containment shells to internal blast loading are presented. The character of response of the shells to dynamic loading is determined with the shells unsupported (suspended in air) and with the shells half-buried in the ground. Geometrical modeling of the re-



sponse is verified for both support conditions. The results of a static pressure test of one vessel show that its dynamic response cannot be predicted from static considerations. (auth)

**14873** CF-58-10-87

Oak Ridge National Lab., Tenn.

LITERATURE PERTINENT TO A STEAM GENERATOR DESIGN FOR A GAS-COOLED REACTOR SYSTEM.

R. I. Gray. Oct. 24, 1958. 28p. Contract [W-7405-eng-26]. \$4.80(ph), \$2.70(mf) OTS.

References to significant design information for a steam generator in a gas-cooled reactor system are presented. Papers concerning heat transfer and pressure drop correlations for gas flow across banks of bare and circular finned tubes and for subcooled water, boiling water, and superheated steam flow inside pipes are listed and briefly discussed. (auth)

**14874** CF-59-5-13

Oak Ridge National Lab., Tenn.

OPERATION OF THE HRT MOCKUP WITH BOILING FUEL IN A TITANIUM PRESSURIZER, RUN CS-23.

R. B. Korsmeyer and P. H. Harley. May 19, 1959. 8p. Contract W-7405-eng-26. \$1.80(ph), \$1.80(mf) OTS.

The 0.045 m  $\text{UO}_2\text{SO}_4$ , 0.036 m  $\text{CuSO}_4$ , 0.025 m  $\text{H}_2\text{SO}_4$  solution (HRT fuel composition) was chemically stable during 1,866 hr of operation at 280°C and 1500 psi. The system was pressurized by boiling a 0.4 gpm stream of the fuel in a titanium heat exchanger at 313°C. During 1,656 hr of operation with the loop at 300°C, three excursions were made to pressurizer temperatures above 330°C where two liquid phases were formed. These tests indicated that heavy phase began formation at 325°C (vapor pressure equilibrium temperature) as evidenced by loss of fuel from the circulating stream. Good heat transfer excluded the possibility of the missing material depositing in the form of a scale in the heat exchanger. In each test, the original fuel composition was restored within six hr after the pressurizer temperature was lowered below 325°C. The generalized stainless steel corrosion rate during operation at 280°C and 1500 psi was 0.6 mpy for the first 700 hr and 1.6 mpy for the next 1166 hr. The average rate during the period when excursions were made into the two-phase region was 3.0 mpy. The apparent increase in corrosion rate is not easily explained because no unusual attack could be found on inspection of the stainless steel surfaces, particularly in the vicinity of the titanium heat exchanger. Boiling fuel solution in a titanium heat exchanger appears to be a practical source of steam for pressurizing an aqueous homogeneous reactor. (auth)

**14875** GA-93

General Atomic Div., General Dynamics Corp., San Diego, Calif.

NEUTRON-FLUX DISTRIBUTION IN A CYLINDRICAL CELL OBTAINED BY THE  $S_4$  APPROXIMATION TO THE TRANSPORT EQUATION. Egil K. Bjørnerud and L. W. Nordheim. Apr. 5, 1957. 43p.

Neutron flux distribution in a cylindrical cell obtained by the  $S_4$  approximation to the transport equation is considered in connection with the design of the Swedish Reactor R3B. The  $S_4$  approximation was recently coded for the IBM-704 computer and was used to solve the problem. (A.C.)

**14876** HW-58000

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

PLUTONIUM RECYCLE PROGRAM. Annual Report,

Fiscal Year, 1958. S. Goldsmith, ed. Nov. 11, 1958. 117p. Contract W-31-109-Eng-52. \$2.75(OTS).

The work performed by the Hanford Laboratories on the Plutonium Recycle Program during fiscal year 1958 is described. Fuel Cycle Analysis: Studies were directed toward establishing a value for plutonium as fuel for thermal reactors. The fuel cycles studied considered sets of variables as determined by (1) single pass or steady state type of recycle, (2) "batch" or "graded" schemes for charging the fuel into the reactor, (3) "spike" or uniform enrichment methods, and (4) fuel processing methods. Physics: In addition to the physics work associated with the fuel cycle analysis, work was performed dealing with calculating effective cross sections, diffusion theory, measurements of lattice parameter, and measurements of plutonium cross sections. Fuel Element Technology: Studies were made on both ceramic and metallic core fuels. Methods of core fabrication, core cladding, and fuel element assembly were developed for a variety of fuel types. Efforts were concentrated on fuel elements of a rod clustered design and a three-component nested tubular design. Chemical Processing Technology: Research and development studies were continued on several chemical processing schemes in order to develop the design requirements for a preferred, completely integrated plutonium recycle system. Aqueous and pyrochemical methods were investigated for processing Pu fuels. It was found that Zr-2 fuel jackets could be dissolved in stainless steel equipment with ammonium fluoride solutions. A mixture of ammonium fluoride and ammonium nitrate was found to be as effective as ammonium fluoride alone for dissolving Zr-2 fuel jackets. This mixture has added advantages of simplifying the off-gas handling problem and also dissolving the tin along with the Zr. It was found that the passive oxide film formed on the Zr-2 cladding when it is exposed to high temperature water can be destroyed by exposing the Zr-2 to an anhydrous melt of  $\text{NH}_4\text{F} \cdot 2\text{HF}$  at temperatures as low as 25°C. Major Experimental Facilities: Construction of two major experimental facilities was started. The Plutonium Fabrication Pilot Plant (PFPP) is designed to investigate a variety of fabrication methods for plutonium-bearing fuel elements. The Plutonium Recycle Test Reactor is heavy water moderated and cooled and contains 85 vertical pressure tubes. The reactor will have the experimental flexibility necessary to investigate a wide range of physics variables and fuel element designs associated with plutonium recycle. Detailed design of the reactor continued during the fiscal year. (For preceding period see HW-52000.) (W.D.M.)

**14877** HW-58333

General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

DESIGN TEST PR-20 CALANDRIA CHARACTERISTICS. Interim Report. R. L. Gruver. Dec. 3, 1958. 23p. Contract [W-31-109-Eng-52]. \$4.80(ph), \$2.70(mf) OTS.

A calandria vessel, a moderator storage tank, and a piping mockup for the PRTR are described, and dump system test data are given and discussed. (T.R.H.)

**14878** IDO-16520

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. PART II. UTILIZATION OF TEST REACTORS. 339p. \$5.00(OTS).

Twelve papers on construction and operation of test reactors and nine papers on the utilization of test reactors are presented. (W.D.M.)

**14879** IDO-16520(p.7-22)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

NUCLEAR TEST REACTOR DESIGN, PROCUREMENT AND CONSTRUCTION PROBLEMS. L. J. Weber. p.7-22 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 16p.

Discussed are some of the mechanical design, procurement, and construction problems encountered during the building of the MTR, ETR, SPERT II, and SPERT III projects at the NRTS. The design and construction of large nuclear test reactors is presently a specialized art, even though many of the difficulties are either similar or identical to their counterparts found in the building of chemical plants, refineries, and other conventional facilities. Differences exist where design requirements peculiar to a reactor require the development of new fabrication or construction techniques, the use of unusual construction materials, closer than usual dimensional tolerances, or particularly restrictive material specifications. The degree of reliability which must be incorporated into certain reactor components, in view of the consequences of failure or inoperability, dictates a rigorous program of prototype development and testing. (auth)

**14880** IDO-16520(p.23-36)

Argonne National Lab., Lemont, Ill.

USE OF D<sub>2</sub>O MODERATED REACTORS FOR TEST AND ENGINEERING IRRADIATIONS. W. H. McCorkle. p.23-36 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 14p.

D<sub>2</sub>O moderated reactors have some unique characteristics which make them desirable for testing and engineering experiments. The CP-5 reactor, which is D<sub>2</sub>O moderated and cooled, has proven to be highly useful in radiation damage studies and for numerous test and engineering investigations through the use of in-pile experiments. Gas cooling of in-pile experiments, though simple in principle, is accompanied by operational problems. Liquid cooling has been successfully applied to autoclave, loop, and other irradiation test experiments. (auth)

**14881** IDO-16520(p.37-75)

Oak Ridge National Lab., Tenn.

OPERATION OF THE OAK RIDGE RESEARCH REACTOR. W. H. Tabor, J. A. Cox, and W. R. Casto. p.37-75 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 39p.

The ORR has operated since July, 1958. Changes in the control rod instrumentation have eliminated nearly all spurious shutdowns. Corrosion of aluminum cast in concrete is being controlled by a vacuum system. Excellent control of the radioactivity in the water systems has been obtained with a demineralizer system, but gaseous activity indicates the need for a degasifier which is being installed. Interaction between the operation of the beam holes and the neutron control chambers has required redesign of the beam hole plugs and the use of auxiliary gamma chambers for level safeties.

The location of the ORR tank in a pool has proved to be very flexible in inserting and removing experiments and in reloading the reactor. (auth)

**14882** IDO-16520(p.77-88)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

CUSTOMER SERVICES AT MTR/ETR. F. L. McMillan. p.77-88 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 12p.

The MTR/ETR, built primarily to carry out the AEC's test programs, is available to educational, research, industrial, and commercial organizations, as well as other Federal Agencies who hold AEC licenses. Under present operating policies, customers who wish to use the irradiation facilities are required to design, fabricate, and ship all equipment necessary in a ready-to-install condition. The assistance given to the customer for this purpose by Phillips is discussed. (W.D.M.)

**14883** IDO-16520(p.89-100)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

INITIAL OPERATING PROBLEMS OF THE ETR. M. E. Thomas. p.89-100 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 12p.

Some of the problems that were encountered in the Engineering Test Reactor during the transition stage from essential completion of construction to the establishment of a full power operating facility are described. Rather than a detailed description of these problems some attempt has been made to define the underlying reason for the difficulties encountered. Particularly is this true where the same type of problems arose during the startup phase of the Materials Testing Reactor some six years earlier. The fact that there were some common problems in the two reactors designed and built by different contractors means that reactor design and construction is still a somewhat specialized art. No attempt is made to correlate the observed nuclear properties of the reactor with design criteria. While there were some problems in this area, from an operating standpoint, the bulk of the difficulties were with the "hardware." (auth)

**14884** IDO-16520(p.101-18)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.

OPERATIONAL EXPERIENCE WITH LOOP AND OTHER EXPERIMENTS. F. R. Keller. p.101-18 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 18p.

The nearly seven years of experience with loops and other experiments is used as a basis for discussing their impact upon reactor operations. The steps leading to the installation and operation of a typical loop are briefly discussed from the operator's viewpoint. A short review of all loops installed and operated in MTR is presented. Power reduction and scram history at MTR for the years 1956, 1957, and 1958 are summarized and analyzed to illustrate the effects of an experimental program upon a test reactor operation. Specific operating problems resulting from experiments are dis-



cussed in detail, using a number of examples from actual experience. (auth)

**14885** IDO-16520(p.119-30)

Phillips Petroleum Co. Atomic Energy Div.,  
Idaho Falls, Idaho.

POLICIES, PROCEDURES, AND PRICING FOR MTR-ETR IRRADIATIONS. J. P. Lyon and R. S. Fisher. p.119-30 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 12p.

Operation of the MTR and ETR as high flux irradiation facilities requires first that the reactors be operated safely as neutron producers and secondly that they be used to provide to the maximum practical extent the types and sizes of irradiation space required by numerous experimental programs. Since many experiments rival the reactors in operating complexity it is necessary to have firm policies and procedures governing reactor operation and the handling of the extensive experimental programs in the reactors. The present policies and procedures applicable to MTR-ETR operations stem partly from Company practice and partly from AEC instructions and regulations. The procedures followed in conducting the experimental programs, the personnel requirements for the reactors and the basis for allocating charges for irradiation space are covered. (auth)

**14886** IDO-16520(p.131-6)

General Electric Co. Vallecitos Atomic Lab.,  
Pleasanton, Calif.

A REPORT ON THE OPERATION OF THE GENERAL ELECTRIC TEST REACTOR. W. S. Prince. p.131-6 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 6p.

A major facility of the Vallecitos Atomic Laboratory is the 30 MW GETR which represents a significant portion of the commercial test reactor space available in the United States at the present time. The GETR is described briefly for purposes of clarity. A general review of factors influencing design, location, and safeguards considerations is presented. Operating experience to date is reviewed and the management of the facility is discussed. The use of a test reactor requires consideration of market, charges for irradiation space and other services, experimental design, and safeguards, and the GETR experience in these areas is presented. The interdependence of the supporting facilities provided by GE at its Vallecitos Atomic Laboratory is discussed. (auth)

**14887** IDO-16520(p.137-44)

Westinghouse Electric Corp. [Atomic Power Div.],  
Pittsburgh.

PREPARING FOR WTR OPERATION. E. T. Morris. p.137-44 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 8p.

Construction of the Westinghouse Testing Reactor was begun July 8, 1957, and was completed on April 12, 1959. Organization and training of operating personnel, construction, and licenses are discussed. (W.D.M.)

**14888** IDO-16520(p.145-54)

Atomic Energy Commission, Washington, D. C.  
CONSIDERATIONS INVOLVED IN THE SAFETY EVAL-

UATION OF TEST REACTORS. Martin B. Biles. p.145-54 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 10p.

An attempt is made to identify the general considerations involved in the hazards evaluation of testing reactors. Heat flux, hydraulic stress, gamma heating, radiation effects, metal-water reactions, reactivity, control, experiments, accidents, and containment are discussed. (W.D.M.)

**14889** IDO-16520(p.155-62)

Phillips Petroleum Co. Atomic Energy Div., Idaho  
Falls, Idaho.

REACTOR AND EXPERIMENT SAFETY CONSIDERATIONS. D. R. deBoisblanc. p.155-62 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 8p.

In nuclear test reactor technology, advanced experiments require the establishment of conditions of high flux and usually high temperatures. The large reactivity effects which can accompany failure of such experiments in test reactors give rise to hazards not commonly associated with ordinary reactor operation. A discussion is given of the problem areas in test technology and of the requirements of hazards evaluation in order to assure safe, continuous operation of a complex nuclear testing program in high flux test reactors like the Materials Testing Reactor and Engineering Test Reactor. The relationship between reactor design, experiment design, and operational safety is discussed from the point of view of the experience and practices of the MTR-ETR Safeguard Committee. The factors that influence the feasibility of operation of various types of engineering tests is discussed. A discussion of recommended practices in relation to research and test reactors and experimental operation is given. (auth)

**14890** IDO-16520(p.163-76)

Phillips Petroleum Co. Atomic Energy Div., Idaho  
Falls, Idaho.

HEALTH PHYSICS PROBLEMS, MONITORING, AND DECONTAMINATION. J. W. McCaslin. p.163-76 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART I. CONSTRUCTION AND OPERATION OF TEST REACTORS. 14p.

An adequate health physics program at a test reactor is wholly dependent upon good design and construction; wholehearted support by management; competent technical and administrative health physics personnel; and sound financial investment and support. The fields covered include proper construction, monitoring instruments with alarms, waste disposal, special supplies and equipment, control procedures, personnel and equipment decontamination, personnel metering, minimum development facilities, and many related requirements. (auth)

**14891** IDO-16520(p.179-90)

Phillips Petroleum Co. Atomic Energy Div., Idaho  
Falls, Idaho.

UTILIZATION AND AVAILABILITY OF MTR AND ETR. R. J. Nertney. p.179-90 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART II. UTILIZATION OF TEST REACTORS. 12p.

The utilization and availability of the MTR and ETR are discussed. Available space in the two reactors is

described briefly in terms of fluxes available, volume of irradiation space, and accessibility in terms of leads and experimental piping. A brief history of the experimental loading of the MTR is given, leading to the present experimental "load-turnover" situation in this reactor. This discussion is broken down in terms of the types of facilities available, e.g., in-tank reflector pieces, beam holes, graphite facilities, etc. The present experimental loading and plans for the future of the ETR are discussed. (auth)

**14892** IDO-16520(p.191-216)

Division of Reactor Development, AEC.

ADVANCED IRRADIATION TESTING REQUIREMENTS FOR TEST REACTORS. R. R. Roof. p.191-216 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART II. UTILIZATION OF TEST REACTORS. 26p.

The scope of a typical irradiation testing program to develop, fabricate, and use a new type reactor fuel element is outlined, based on experience in the PWR (Shippingport) Project. Advanced irradiation testing requirements for in-pile space, neutron flux, and in-pile loop design are given in considerable detail. (auth)

**14893** IDO-16520(p.217-40)

Battelle Memorial Inst., Columbus, Ohio.

EXPERIENCES WITH THE DESIGN, CONSTRUCTION, AND OPERATION OF IN-PILE RECIRCULATING GAS-COOLED LOOPS FOR FUEL-SUBASSEMBLY TESTS. S. L. Fawcett and G. A. Francis. p.217-40 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART II. UTILIZATION OF TEST REACTORS. 24p.

Over the past  $2\frac{1}{2}$  years, experience has been gained by the design, construction, and operation of two recirculating gas-cooled in-pile-loop test facilities. One was installed and operated intermittently over a period of about a year at the Battelle Research Reactor; and the other is now being put into operation at the Engineering Test Reactor. Operating requirements of the specimens to be evaluated and the test reactor in which the facility is to be installed dictate most of the loop design characteristics. In addition, the hazards and safety considerations of these types of experiments force strict conservatism on the designers. The design features of both facilities were based on these considerations. Both facilities were given preoperational tests before insertion into their respective reactors. The problem of fuel element transfer at the BRR involved keeping the loop and specimen dry while performing an underwater operation. Maintenance problems were encountered and solved during experiment operation at the BRR. The use of in-pile-loop experiments is both a complex and expensive method of evaluating a nuclear fuel subassembly but the experiments fulfill a developmental function for which there is no substitute. (auth)

**14894** IDO-16520(p.241-54)

General Electric Co. Aircraft Nuclear Propulsion Dept., Idaho Falls, Idaho.

A DESCRIPTION AND OPERATING HISTORY OF THE MTR HT-1 LOOP. J. D. Provost. p.241-54 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART II. UTILIZATION OF TEST REACTORS. 14p.

A general description is given of the experimental equipment used by the General Electric Company—ANPD in pursuing its work toward direct cycle aircraft nuclear propulsion at the Materials Testing Reactor in

Idaho. The HT-1 loop auxiliary and supporting equipment is described including inpile tubes and removal casks. Operational experience is given on procedures such as sample removal, inpile tube change-out, and flux measurement. (auth)

**14895** IDO-16520(p.255-64)

Brookhaven National Lab., Upton, N. Y.

LIQUID METAL IRRADIATIONS AND TESTS IN THE BROOKHAVEN REACTOR. R. A. Meyer. p.255-64 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART II. UTILIZATION OF TEST REACTORS. 10p.

Recent fuel element changes in the Brookhaven reactor increased the thermal flux to  $2 \times 10^{13}$  n/cm<sup>2</sup>/sec. Irradiations were conducted in this reactor to study chemical and property changes of liquid metals and container materials. Details of these tests and reactor conditions are presented. (auth)

**14896** IDO-16520(p.265-80)

General Electric Co. Hanford Atomic Products

Operation, Richland, Washington.

DESIGN OF HANFORD LOOPS IN THE MTR AND ETR. D. C. Kaulitz. p.265-80 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART II. UTILIZATION OF TEST REACTORS. 16p.

Hanford has in place, or under construction, in the MTR and ETR three facilities intended for the irradiation of fuel assemblies. One of these is one-pass pin-type loop utilizing MTR make-up water for coolant and permitting the irradiation of advanced fuel element types which have been defected, which are to be intentionally ruptured in the reactor, or on which the rupture potential is, as yet, undetermined. The facility was designed so that elements could be irradiated and discharged for examination and recharged for further irradiation. In the ETR, Hanford is installing two recirculating high pressure loops—one of which (the  $3 \times 3$  loop) is located in the reflector and the other of which ( $6 \times 9$  loop) is located in the core. In both of these loops, the fuel specimens are contained in baskets or holders isolating the fuel specimen from the pressure tube so that failure of a metallic uranium element in high temperature water, or extensive warping, bowing, or swelling of the element can be tolerated without damage to the pressure tube. Both loops are designed to permit recharging of irradiated specimens so that a specimen may be examined at intervals as an irradiation proceeds. The design features of these loops which simplify operation of the loop, permit irradiation of new untested elements without endangering the pressure tube or the reactor; or which facilitate measurement of the conditions pertaining during irradiation is discussed. (auth)

**14897** IDO-16520(p.281-94)

Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho and General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

HANFORD FUEL EXPERIMENTS IN THE MTR AND ETR. Robert Neidner. p.281-94 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART II. UTILIZATION OF TEST REACTORS. 14p.

Hanford has carried out, during the past several years, a series of capsule and fuel experiments in the MTR and is initiating a series of experiments in the ETR. Experiment designs which permit measurement



of water temperature during the experiment are discussed. Methods of introducing thermocouples into the experimental pieces are discussed. An experiment was carried out in which a fuel specimen is defected in the reactor during reactor operation. A simplified method for removal of the in-reactor tube from the reactor was developed, and found to permit rapid and safe removal of the tube. (auth)

**14898** IDO-16520(p.295-316)

Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn.

A LOOP FOR DYNAMIC INPILE TESTING OF FUEL ELEMENTS IN A FLOWING LIQUID METAL COOLANT. R. W. Kelly and G. U. Parks, Jr. p.295-316 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART II. UTILIZATION OF TEST REACTORS. 22p.

A contained circulating liquid metal loop experiment was designed and developed for the purpose of testing fuel elements and nuclear materials at elevated temperatures in the Engineering Test Reactor. Test specimens are cooled by a flowing sodium-potassium alloy which is circulated by means of a canned centrifugal pump. The heat which is generated in the experiment is rejected to the test reactor process water through a unique three fluid heat exchanger. Test specimen temperatures are controlled solely by varying the heat dissipation rate; auxiliary heating systems are not employed. Post-irradiation handling and removal of the apparatus is accomplished so as to make full use of the reactor process water as a radiation shield, thereby eliminating the need for complicated equipment and additional shielding. A suitable radiation resistant pump drive motor and thermocouple was developed for use in this experiment. Flux determination experiments were completed with nuclear mock-ups in the Engineering Test Reactor Critical Facility and developmental testing is being completed with the operation of a full power non-nuclear mock-up of the inpile experiment. (auth)

**14899** IDO-16520(p.317-39)

General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.

FUNDAMENTAL FACTORS OF TEST REACTOR DESIGN. Bertram Wolfe. p.317-39 [of] TEST REACTORS MEETING FOR INDUSTRY, IDAHO FALLS, IDAHO, MAY 13-15, 1959. PART II. UTILIZATION OF TEST REACTORS. 23p.

The characteristics of water moderated and cooled test reactors are described with emphasis on the neutron and gamma flux levels which are and can be attained. The improvements made possible by using other moderators in a multifacility reactor are examined. It is concluded that the major gain is the ability to operate at higher reactor powers due to the larger core regions in say, a heavy water reactor. The characteristics of low absorbing homogeneous reactors, and flux trap reactors are reviewed from the viewpoint of producing the highest flux possible. It is pointed out that both reactor types are inefficient in terms of the absorption in experiments of a high percentage of available neutrons. The incentive for a soluble poison control system is discussed. The value of the reflector region in a test reactor is outlined. An attempt is made to describe and understand the characteristics and limitations of test reactors and their available radiations from a fundamental viewpoint, without recourse to extensive, hard to interpret computer studies. (auth)

**14900** JAERI-4006

Japan. Atomic Energy Research Inst., Tokyo. USEFUL CHARTS TO FIND INDICIAL RESPONSE OF THERMAL REACTORS. Report No. 6. Junichi Mida and Nobuhide Suda. 1959. 26p.

Charts are presented from which indicial response of thermal reactors is easily obtained. The charts are of two kinds: one gives time constants for a definite magnitude of reactivity step change and the other gives neutron density coefficients. (W.D.M.)

**14901** ORNL-2559

Oak Ridge National Lab., Tenn.

INITIAL POST NEUTRON MEASUREMENTS IN THE ORR. C. D. Cagle and R. A. Costner, Jr. June 10, 1959. 56p. Contract W-7405-eng-26. \$1.75(OTS).

The first approach to criticality of the ORR (ORNL Research Reactor) was completed at 6:06 PM, March 21, 1958. Following the initial instruments and controls performance checks using a small core, full-size cores were assembled for the post neutron measurements. The measurements included core and rod reactivity calibrations, the temperature coefficient, the reactivity effects of voids, the reactivity effects of experiments, the reactivity effects of fuel additions, and the spatial distribution of the thermal neutron flux. The results of the measurements are given together with discussions of the methods. (auth)

**14902** P-1500(RAND)

RAND Corp., Santa Monica, Calif.

ON CONTROL OF REACTOR SHUT-DOWN INVOLVING MINIMAL XENON POISONING. Milton Ash, Richard Bellman, and Robert Kalaba. Oct. 3, 1958. 14p.

After a high-flux thermal nuclear reactor is shut down, the concentration of fission product xenon may rise for many hours as a result of the decay of fission product iodine into  $Xe^{135}$ . This results in reactor poisoning and may, with consequent loss of efficiency, postpone the time at which the reactor may be restarted. This poisoning may be minimized by carefully controlling the rate at which the neutron flux is decreased during the shut-down operation. The determination of optimal control in this situation leads to some non-classical problems in the calculus of variations. It is shown how they can be treated by the functional equation technique of dynamic programming. The methods presented rely upon the use of high-speed digital computers with large memories. The method automatically produces a valuable parameter study and results in stable designs. (auth)

**14903**

RESEARCH AND EXPERIMENTAL REACTORS IN THE EURATOM AND OEEC COUNTRIES. *Atomwirtschaft* 4, 145-9(1959) Apr. (In German)

A tabulation of the research and experimental reactors in operation, under construction, or being planned in the Euratom and OEEC countries is presented. (J.S.R.)

**14904**

THERMODYNAMIC FACTORS IN THE SELECTION OF THE COOLANT FOR NUCLEAR REACTORS. L. S. Dzung (Brown, Boveri and Cie, Baden, Switzerland). *Inds. atomiques* 3, No. 3/4, 59-64(1959). (In French)

The effects of the thermodynamic factors of various reactor coolants were studied by a consideration of the necessary circulation power. This power depends on three factors: the thermal charge, the construction arrangement, and the characteristic physical constants of

the substance. As an example, parameters for  $H_2$ , He,  $CO_2$ , and air are calculated. (J.S.R.)

#### 14905

MARINE PROPULSION PROJECTS. Nuclear Eng. 4, 193-6(1959) May.

A review of marine reactor development is presented. The most comprehensive naval program is in progress in the U. S. The U. K. and France also have nuclear naval ship projects. Non-naval nuclear powered ships include the Lenin, a Russian built ice breaker said to be the first nuclear powered surface ship. Merchant ship programs are given for various countries, such as Denmark, Germany, Holland, Italy, Japan, and others. U. S. Navy nuclear projects are tabulated. (J.R.D.)

#### 14906

THERMAL BUCKLING OF CRUCIFORM CONTROL RODS. John E. Goldberg and M. F. Sankovich (Purdue Univ., Lafayette, Ind. and Babcock and Wilcox Co., Lynchburg, Va.). Nuclear Sci. and Eng. 5, 215-18(1959) Apr.

A criterion is derived for thermal torsional buckling of a cruciform bar subjected to transverse temperature gradients, and a numerical procedure for the evaluation of this criterion is presented. The problem is of interest in connection with the design and selection of control rods for nuclear reactors. (auth)

#### 14907

MAGNESIUM-CLAD WEDGE S-SHAPED FUEL PLATES FOR GAS-COOLED REACTORS. Guy H. Cannon (Dow Chemical Co., Midland, Mich.). Nuclear Sci. and Eng. 5, 219-24(1959) Apr.

Heat output of a nuclear reactor is independent of temperature and is limited only by the rate at which heat can be removed from the system. Means are suggested for improving the heat removal capability of a reactor by redistributing the fuel, shaping the heat-transfer surface, and directing the flow of coolant in a manner such as to cause all of the increased heat-transfer surface to operate at the highest permissible temperature and thereby maximize the temperature difference applicable for heat-transfer. With "Calder Hall" as a reference and employing the same materials of construction and proportions (fuel, cladding, moderator, coolant), and using the same operating conditions (coolant pressure, coolant pumping power, maximum cladding temperature), this paper suggests ways of fabricating equivalent magnesium-clad wedge S-shape fuel plates and using them in clumps for heating more coolant to higher temperature. The indicated result is greatly increased power production because of increased coolant throughput at increased outlet temperature and improved thermal efficiency. (auth)

#### 14908

RESONANCE ESCAPE PROBABILITY IN WATER LATTICE. Hiroshi Takahashi (Japan Atomic Energy Research Inst., Tokyo). Nuclear Sci. and Eng. 5, 237-41(1959) Apr.

In light water-moderated reactors the effects of adjacent fuel on resonance escape probability must be considered. These effects are a decrease of surface absorption and modification of the slowing down density by absorption. Modifications of the standard formula for calculating  $p$  are described and the results of detailed calculations on enriched uranium-dioxide fuel rods in water lattices are given. The effective resonance integral is calculated by the method of Wigner et al. (auth)

#### 14909

ON THE VALIDITY OF THE SECOND FUNDAMENTAL THEOREM FOR SMALL REACTORS. Erdal Ifionu (Princeton Univ., N. J.). Nuclear Sci. and Eng. 5, 248-53(1959) Apr.

The second fundamental theorem of reactor theory gives a general expression for the nonescape probability. To check the validity of this expression for small sizes, first-flight nonescape probabilities are calculated for neutrons which have originated from either a persisting or a uniform stationary distribution in slabs of half-widths ranging from 0.1 to 10 mean free paths. Exact values computed directly from the integral formulation are compared with the approximate values obtained by expanding the distributions in eigen solutions of the wave equation and applying the general theorem, assuming that the linear extrapolation of the final flux vanishes on the extrapolation surface. It is found that the nonescape probabilities given by the fundamental theorem remain quite accurate even when the size of the reactor is decreased to the order of the mean free path. For a slab which is only two mean free paths wide, the fractional difference from the exact value is 1.5 per cent for the persisting distribution and 2.5 per cent for the uniform distribution. (auth)

#### 14910

THE DYNAMIC REACTIVITY INTERPRETATION OF PULSED NEUTRON MEASUREMENTS. B. E. Simmons (Knolls Atomic Power Lab., Schenectady, N. Y.). Nuclear Sci. and Eng. 5, 254-6(1959) Apr.

A dynamic reactivity, not the reactivity in general use, is defined relative to prompt critical as  $\Delta K = -\lambda\alpha$ , where  $\alpha$  is the asymptotic (prompt) flux decay rate observed in a pulsed neutron experiment, and  $\lambda$  is the prompt generation time of that same reactor made prompt critical by uniform subtraction of  $1/v$  poison. The dynamic reactivity coalesces near critical with the conventional perturbation reactivity  $\delta v/v$ . The dynamic reactivity is physically interpretable as the amount of uniform  $1/v$  poison whose removal would result in criticality, times the conventional reactivity coefficient of that poison in the critical reactor. The quantity  $\lambda$  has the physical significance of the average time taken by a neutron to cause a fission in the steady-state prompt-critical reactor;  $\lambda$  is also the reactivity coefficient just mentioned. (auth)

#### 14911

A STUDY OF SPLIT CORES FOR RESEARCH REACTORS. F. E. Jablonski and R. S. Carter (Naval Research Lab., [Washington, D. C.]; General Motors Corp., Detroit; and Westinghouse Research Labs., [East Pittsburgh, Penna.]). Nuclear Sci. and Eng. 5, 257-63(1959) Apr.

Beam experiment backgrounds can be reduced by splitting the reactor core so that beam ports view moderator rather than fuel. Multigroup calculations have been performed on  $D_2O$  and  $H_2O$  split core reactors. Measurements of flux distributions for an  $H_2O$  split core are in agreement with the calculations. Thermal flux in the center of the moderator gap is greater than a standard core flux at the same power. The fast neutron and gamma ray spectra have been calculated for a beam port viewing moderator and viewing fuel. Measurements of fast neutron current from an  $H_2O$  reactor using an aluminum threshold detector indicate a factor of 10 reduction in fast flux by viewing moderator. The control characteristics of  $D_2O$  and  $H_2O$  split cores do not



appear significantly different from those of standard cores. (auth)

#### 14912

REACTOR SIMILITUDE. S. Pearlstein (Knolls Atomic Power Lab., Schenectady, N. Y.). Nuclear Sci. and Eng. 5, 269-70(1959) Apr.

A review is given of some dimensionless parameters that may be used for the simplification of nuclear reactor experiments. The following parameters are discussed: neutron leakage, thermal utilization, control, and disadvantage factors. (J.H.M.)

#### 14913

AN EMPIRICAL CORRELATION OF THE EXPERIMENTAL DATA ON HOMOGENEOUS, HIGHLY ENRICHED URANIUM-HYDROGEN CRITICAL ASSEMBLIES. I, CHANGES OF GEOMETRY. B. G. Owen and R. A. Gibson (Dounreay Experimental Reactor Establishment, Caithness, Scotland). Reactor Technol. 1, 10-14(1959) Apr.

An empirical approach is proposed to the determination of a constant ( $B_0^2$ ) of the materials of the critical assembly which corresponds to the material buckling. By using two empirical equations and the one-group geometrical buckling relations any change of geometry, reflected by hydrogenous materials or unreflected, may be accomplished for simple shapes. (auth)

#### 14914

THE USE OF ELECTRONIC DIGITAL COMPUTERS IN A STUDY OF HIGH TEMPERATURE GAS COOLED REACTORS. D. V. Wordsworth (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Reactor Technol. 1, 25-34(1959) Apr.

Electronic digital computer techniques used at Harwell in feasibility studies of high-temperature gas-cooled reactors are described. The program is divided into sections and those amenable to hand calculation are started by hand and more important or more urgent computations are programmed for the computers. (T.R.H.)

#### 14915

ATOMIC ENERGY PILE. E. D. Courant (Canada). British Patent 801,651. Nuclear Eng. 4, 238(1959) May.

The pile has a core dimensioned slightly below critical size. The control members contain an amount of fissile material equivalent to at least 1.5% of their weight and larger than the amount of fissile material in the core substance. Initially, the control rods need only be inserted a short distance to bring the multiplication factor to a value exceeding 1. But, when the pile activity drops, the rods are inserted farther. The design is of particular interest in connection with breeder piles.

#### 14916

NUCLEAR REACTOR FUEL ELEMENT HANDLING PLANT. W. R. Wootton and Babcock and Wilcox, Ltd. British Patent 802,285. Nuclear Eng. 4, 238(1959) May.

Details are given of a reactor servicing machine which facilitates the removal of a fuel element from its operational position by passing it down a disposal tube, in which a head of liquid is maintained in order to limit the velocity of descent. The lower end of the disposal tube is submerged in a liquid held in a pressurized chamber, and its position is adjustable to facilitate loading the discharged fuel element into a truck, by means of which it is withdrawn from the pressurized chamber through a pipe fitted with a gate valve to a general storage reservoir for disposal by normal transport.

#### 14917

NUCLEAR REACTOR FUEL ELEMENTS. Babcock and Wilcox, Ltd. (Germany). British Patent 802,805. Nuclear Eng. 4, 238(1959) May.

In order to ensure uniform heat transfer, a sheathed fuel rod should have contact with the sheath over as large a surface as possible. Where such contact is restricted to a few points, there is a danger of overheating. In order to overcome this risk, it is proposed to employ rods of comparatively small diameter and to position same in the axis of the sheath employing spacers, such as bosses, ribs, or distance rings. The spacers should be made of non-fissile material with a melting point higher than that of the material of the rod or the sheath.

#### 14918

NUCLEAR REACTOR FUEL ELEMENTS. Babcock and Wilcox, Ltd. (Germany). British Patent 802,806. Nuclear Eng. 4, 238(1959) May.

The fuel elements are designed to fit cylindrical apertures in the moderator body. Their sheaths have external projections which keep the fuel elements clear of the surrounding moderator material. The space between sheath and moderator provides a passage for the coolant.

#### 14919

COOLING OF NUCLEAR REACTORS. R. A. Gustison and Union Carbide Corp. (U.S.A.). British Patent 802,938. Nuclear Eng. 4, 238(1959) May.

The fuel elements are immersed in a bath of liquid niobium pentafluoride connected to a heat exchanger. Niobium pentafluoride can be used at a higher temperature than water and no pumping difficulties arise as would be the case with alkali metals. Standard heat-transfer units can be employed. No special corrosion-resistant materials need be used in construction.

## Power

#### 14920 AECU-4151

Duquesne Light Co., Shippingport, Penna.  
FUEL HANDLING, SERVICE AND WASTE DISPOSAL BUILDINGS DRAIN TEST. SECTION I. Test Results DL-S-230 (T-641115). First issue, Mar. 31, 1959. 10p. \$1.80(ph), \$1.80(mf) OTS.

The testing of nonactive drains, special drains, sanitary drains, chemical waste drains, and storm sewer drains by means of water flow and visual inspection is discussed. (auth)

#### 14921 AECU-4157

Duquesne Light Co., Shippingport, Penna.  
CONTROL ROD POSITIONS FOR CRITICALITY. SECTION 1. FOURTH PERFORMANCE. Test Results DL-S-149 (T-550130). First issue, Mar. 24, 1959. 14p. \$3.30(ph), \$2.40(mf) OTS.

A test was made to determine critical bank worths for various rod configurations at ambient temperature. Critical bank heights and bank worths at a coolant temperature and pressure of 130°F and 430 psig are listed. The test was performed after 556.6 EFPH of operation. (A.C.)

#### 14922 AECU-4158

Duquesne Light Co., Shippingport, Penna.  
CONTROL ROD POSITION FOR CRITICALITY. SECTION II. 1692.8 EFPH. FIFTH PERFORMANCE. Test Results DL-S-149 (T-550130). First issue, Mar. 24, 1959. 28p. \$4.80(ph), \$2.70(mf) OTS.

The critical rod bank positions and bank worths at 6 different control rod configurations at 520°F and 1780 psig were determined after 1692.8 EFPH's of reactor operation. (T.R.H.)

#### 14923 AECU-4160

Duquesne Light Co., Shippingport, Penna.  
REACTOR AUTOMATIC CONTROL AND LOAD SWING TEST. SECTION I. SECOND PERFORMANCE. Test Results DL-S-164 (T-554924). First issue, Mar. 25, 1959. 21p. \$4.80(ph), \$2.70(mf) OTS.

The controlling ability of the reactor power and temperature control system and the operational characteristics of the station during load swings were determined after changing operating conditions from 523°F, 2000 psi, to 500°F, 1800 psi. The reactor power and temperature control system satisfactorily controlled rod movements to maintain all primary plant parameters within their individual limits during steady-state operation and during ramp function load changes of 25 mw/min. Load swings were performed with the reactor in manual control and all primary plant parameters were maintained satisfactorily. (A.C.)

#### 14924 AECU-4161

Atomic Power Development Associates, Inc., Detroit.  
SODIUM-AIR ACCIDENT STUDY FOR A SODIUM COOLED REACTOR. Technical Memorandum No. 20. Edward Garelis. Apr. 6, 1959. 22p. \$4.80(ph), \$2.70(mf) OTS.

The design requirements of a containment building for a sodium-cooled reactor have been investigated from the point of view of a hypothetical sodium-air reaction. In particular, this study was directed toward the containment building of the Enrico Fermi Atomic Power Plant. The hypothetical accident assumes a major leak in the sodium system with a concurrent or earlier failure of the ventilation and cooling system, which allows air to enter the areas around the sodium system which are normally maintained in an atmosphere inert insofar as sodium burning is concerned. The resulting sodium pool, equivalent in burning surface to the fraction of the cross sectional area of the containment building, which is flooded, burns at a rate depending upon oxygen concentration and gas temperature in the containment building. A series of experiments were carried out to determine this burning rate and its mechanism. The resulting gas temperature and pressure due to the sodium-air incident were determined by solving a system of equations based on time dependent heat balances on the containment building and its contents. The assumed incident gives a maximum gas pressure of about 26 psig and a corresponding gas temperature of 1115°F. This pressure is well below the design pressure of 32 psig for the containment vessel. In addition to the study of the sodium-air reaction in the assumed incident, the theoretical maximum pressure and temperature for the constant volume adiabatic sodium-air reaction is also discussed. (auth)

#### 14925 CENC-1021

Combustion Engineering, Inc. Nuclear Components [Dept.], Chattanooga.  
THERMAL TEST REPORT PWR TEST VESSEL AND FINAL TEST HEAD. J. S. Hucks and J. W. Anderson. Aug. 1958. 78p. For [Westinghouse Electric Corp. Bettis Plant]. CE Contract No. 7954-14. \$13.80(ph), \$4.80(mf) OTS.

Results of the PWR thermal cycling tests pertinent to transient heat flow through various sections of the test

vessel and final test head are presented. The final test head is identical in over-all dimensions and penetration pattern to the actual PWR vessel head which is not operational at Shippingport, Pennsylvania. The ramifications and limitations resulting from the assumed boundary conditions and material thermophysical properties in the solution of the transient conduction heat flow problem are discussed. A comparison is made of transient temperature profiles and thermal gradients for various sections of the vessel and head obtained experimentally with those obtained analytically. The experimental and analytical results are found to be in agreement. (auth)

#### 14926 IDO-28538

Aerojet-General Nucleonics, San Ramon, Calif.  
ARMY GAS-COOLED REACTOR SYSTEMS PROGRAM. Monthly Progress Report [for] March 1959. Apr. 30, 1959. 54p. Contract AT(10-1)-880. \$9.30(ph), \$3.60(mf) OTS.

The activities of the Army Gas-Cooled Reactor System Program are given. The program includes a water-moderated heterogeneous reactor (Gas-Cooled Reactor Experiment I), a graphite-moderated homogeneous reactor (Gas-Cooled Reactor Experiment II), a portable gas-cooled reactor (ML-1), and the coordination of the Gas Turbine Test Facility. The progress of each project, the associated tests and data evaluation, the applicable design criteria, and the fabrication of the reactor components are reported. (auth)

#### 14927 KAPL-M-JED-1

Knolls Atomic Power Lab., Schenectady, N. Y.  
APPRAISAL OF ELECTRICAL DISTRIBUTION SCHEMES FOR REACTOR FILL SYSTEM. J. E. Doescher and E. F. Vitek. Mar. 30, 1959. 19p. Contract W-31-109-Eng-52. \$4.80(ph), \$2.70(mf) OTS.

Proposals for an electrical distribution system design to accommodate a 225 hp reactor fill pump and a 450 hp reactor fill pump in a two reactor pressurized water plant are presented. Both proposals are similar in many respects but differ basically in the alternate power source for the reactor fill system. (W.D.M.)

#### 14928 MND-MPR-1646

Martin Co. Nuclear Div., Baltimore.  
NUCLEAR STUDIES ON THE MPR ZERO POWER TEST CORE. H. B. Rosenthal and E. A. Scicchitano, eds. Dec. 23, 1958. 315p. Contract AT(30-3)-277. \$5.00(OTS).

The MPR zero power test program providing experimental data to evaluate the methods and results of analytical MPR nuclear calculations was completed. In addition to obtaining information needed for the final MPR core design, sufficient data were obtained to serve as a guide for modifications of the core design. In some instances, experimental results were obtained for items that did not lend themselves readily to theoretical analysis. A description of the Martin Critical Experiment Facility, the zero power test reactor system, and the experimental equipment is summarized. Prototype fuel elements were used, the specifications of which are given. Two basic cores were analyzed in the test program. These core configurations, core loadings, and design specifications are shown. The original program for evaluating the six-Y-shaped rod control system was expanded to include the design and evaluation of a control system with seven Y-shaped rods. This change was necessary to meet the design requirement that n-2 rods (where n is the number of rods) would shut down the reactor at any time of core life for the



MPR. Other design modifications of the MPR, such as relocation of the thermal shield and pressure vessel, were incorporated into this program. Results of these nuclear studies of the MPR zero power test reactor include critical core configuration, full size core reactivities, neutron flux and power distributions for all major configurations, and reactivity effects due to flow baffles, thermal shields, temperature changes, and control rods. The results of these experimental and theoretical studies, with a comparison of the two, where applicable, are presented. (auth)

**14929** NASA-M-2-20-59E

National Aeronautics and Space Administration.

Lewis Research Center, Cleveland.

**A 20,000-KILOWATT NUCLEAR TURBOELECTRIC POWER SUPPLY FOR MANNED SPACE VEHICLES.**

Robert E. English, Henry O. Slone, Daniel T. Bernatowicz, Elmer H. Davison, and Seymour Lieblein. Mar. 1959. 65p.

A conceptual design of a nuclear turboelectric powerplant suitable for manned space vehicles is presented. A thermodynamic cycle using sodium vapor as the working fluid and operating at a turbine-inlet temperature of 2500°R was selected. The total powerplant weight was calculated to be approximately 6 pounds per kilowatt. The radiator necessary for rejecting cycle waste heat contributes approximately 2.1 pounds per kilowatt to the total weight, whereas the reactor and reactor shield contribute approximately 0.24 and 1.2 pounds per kilowatt, respectively. (auth)

**14930** NP-7512

Pacific Gas and Electric Co., San Francisco.

**HUMBOLDT BAY POWER PLANT.** Unit No. 3, Exhibit B. Preliminary Hazards Summary Report. Apr. 15, 1959. 157p. \$28.80(ph), \$8.40(mf) OTS.

Information is presented to provide reasonable assurance that the proposed plant can be constructed and operated without undue risk to the health and safety of the public. The unit employs a single-cycle, natural-circulation, boiling-water reactor to produce steam which is used directly by a steam turbine. The thermal, heterogeneous reactor uses slightly enriched uranium oxide as fuel and water as moderator and coolant. The main features of the unit are described with particular emphasis on the site and its environs, along with a preliminary analysis of the project from the safety standpoint. (A.C.)

**14931** NP-7539

United Kingdom Atomic Energy Authority. Industrial Group. Dounreay Experimental Reactor Establishment, Caithness, Scotland.

**FAST REACTOR NEWSLETTER.** J. L. Phillips, comp. May 1959. 6p.

The testing of all flasks and handling equipment is almost complete. Modifications necessary to ensure satisfactory operation have been made. The natural uranium elements have been loaded into the core. A total of 74 tons of liquid metal has been melted and is held in the dump tanks. Filling the primary circuit with liquid metal is due to start soon. Criticality during July is programmed. (A.C.)

**14932** ORNL-2699

Oak Ridge National Lab., Tenn.

**GAS-COOLED REACTOR COOLANT CHOICE.** June 15 1959. 23p. Contract W-7405-eng-26. \$1.00(OTS).

A compilation is presented of the technical information presently available which bears on the problem of

selecting a coolant for the graphite-moderated gas-cooled reactor. The problems with respect to helium containment and availability, the status of the technology on carbon dioxide-graphite reactions, the influence of coolant choice on power cost, and the compatibility of carbon dioxide with various fuel cladding materials are discussed. (auth)

**14933** UCRL-5465

California. Univ., Livermore. Lawrence Radiation Lab.

**THE TORY II REACTOR CONTROL SYSTEM: DESCRIPTION, DESIGN, AND SELECTION OF COMPONENTS.** Robert E. Finnigan. Feb. 3, 1959. 117p. Contract W-7405-eng-48. \$2.75(OTS).

Tory II, the first experimental reactor in the Pluto nuclear ramjet program, will be tested in the near future at the Nevada Test Site of the AEC. The fundamental objective of Tory II is to demonstrate that a high power-density, high-temperature, air-cooled reactor can be successfully designed, constructed, and operated. This application places requirements on the reactor control system which are considerably more stringent than those found in most reactor systems. The control concepts are outlined which have been formulated for Tory II. The design of the multi-mode control system used for reactor power level control is described in detail; synthesis of an optimum automatic control system is carried out using frequency response and root-locus methods in conjunction with both digital and analog computers. (auth)

**14934**

**INCORPORATION OF ATOMIC ENERGY IN THE SPANISH ELECTRICAL SYSTEM.** Manuel G. Cortines. *Energía nuclear (Madrid)* 3, No. 9, 27-37 (1959) Jan.-Mar. (In Spanish)

The future power needs of Spain are reviewed, and the contribution of atomic energy to meeting these requirements is estimated. The contributions of hydroelectric and conventional thermal power are also considered. (J.S.R.)

**14935**

**A UO<sub>2</sub>-LIQUID METAL SLURRY REACTOR FOR ECONOMIC POWER.** J. K. Davidson, W. L. Robb, O. N. Salmon, and J. B. Sampson (Knolls Atomic Power Lab., Schenectady, N. Y.). *Nuclear Sci. and Eng.* 5, 227-36 (1959) Apr.

An application of a UO<sub>2</sub>-liquid metal slurry reactor to a stationary power station is described. The fuel, consisting of a UO<sub>2</sub> suspension in liquid bismuth, is pumped through a moderator matrix and an external heat exchanger. Low initial enrichment, long fuel life, and low fuel fabrication costs, combined with a low-pressure reactor, indicate a competitive electrical generation cost. The use of natural uranium feed in one of the modes of operation of this reactor system is shown to be possible. Experiments on the dispersion of UO<sub>2</sub> in bismuth are reported. (auth)

## STABLE ISOTOPE SEPARATION

**14936**

**THE ENRICHMENT OF LITHIUM ISOTOPES BY ION-EXCHANGE CHROMATOGRAPHY. I. THE INFLUENCE OF THE DEGREE OF CROSSLINKING ON THE SEPARATION FACTOR.** D. A. Lee and G. M. Begun

(Oak Ridge National Lab., Tenn.). *J. Am. Chem. Soc.* **81**, 2332-5(1959) May 20.

Single stage separation factors have been determined for  $\text{Li}^6$  and  $\text{Li}^7$  between aqueous lithium ions and lithium ions on sulfonated polystyrene-divinylbenzene copolymers of various degrees of crosslinking. A band elution technique on an ion-exchange column was used. The single stage separation factor,  $\alpha$ ,  $(\text{Li}^6/\text{Li}^7)_{\text{resin}}/(\text{Li}^6/\text{Li}^7)_{\text{aqueous}}$ , was determined according to the method of Glueckauf from the elution curve and isotopic assays. Variations in  $\alpha$  (1.0006 to 1.0038) with the degree of crosslinking can be explained by a simple concept of partial "dehydration" of lithium ions in the resin phase. Assuming a model for the lithium ion species in the two phases, the magnitude of  $\alpha$  can be estimated quantum mechanically. (auth)

#### 14937

SEPARATION OF BORON ISOTOPES. III. THE *n*-BUTYL SULFIDE- $\text{BF}_3$  SYSTEM. A. A. Palko (Oak Ridge National Lab., Oak Ridge, Tenn.). *J. Chem. Phys.* **30**, 1187-9(1959) May.

The gas-liquid isotopic exchange between  $\text{BF}_3$  and the *n*-butyl sulfide- $\text{BF}_3$  complex was studied as a possible system for enriching boron isotopes. The single stage separation factor varied from 1.054 at  $-20^\circ\text{C}$  to 1.033 at  $26^\circ\text{C}$ .  $\text{B}^{10}$  concentrated in the liquid phase. The heat of association of the *n*-butyl sulfide-boron trifluoride complex was determined to be  $-12.76 \pm 0.06$  kcal/mole from a series of vapor pressure measurements of the complex made at several mole ratios of  $\text{BF}_3$  to sulfide. (auth)

#### 14938

NITROGEN ISOTOPIC FRACTIONATION BETWEEN NITRIC ACID AND THE OXIDES OF NITROGEN. L. L. Brown and G. M. Begun (Oak Ridge National Lab., Tenn.). *J. Chem. Phys.* **30**, 1206-9(1959) May.

The single-stage nitrogen isotopic separation factor between nitric acid and the oxides of nitrogen has been measured as a function of temperature and nitric acid concentration. Nitric acid molarities were varied from 1.084 to 15.45 and temperatures from  $26$  to  $70^\circ\text{C}$  were used. The separation factor was found to vary from 1.01 to 1.064, with nitrogen-15 concentrating in the nitric acid phase. The experimental data are compared with values calculated from spectroscopic and chemical data. (auth)

#### 14939

OXYGEN ISOTOPE FRACTIONATION IN THE SYSTEM CALCIUM CARBONATE-WATER. Robert N. Clayton (Pennsylvania State Univ., University Park). *J. Chem. Phys.* **30**, 1246-50(1959) May.

The oxygen isotope exchange reaction between water and calcium carbonate has been studied over the temperature range  $190^\circ\text{C}$  to  $750^\circ\text{C}$ . Equilibrium constants for the reaction have been measured and fit the equation  $\ln K = 2725T^{-2}$  for all temperatures above  $0^\circ\text{C}$ . The implications to geological thermometry are discussed. (auth)

#### 14940

DEUTERIUM ISOTOPE EFFECT IN THE REACTION OF HYDROGEN MOLECULES WITH CHLORINE ATOMS AND THE POTENTIAL ENERGY OF THE  $\text{H}_2\text{Cl}$  TRANSITION COMPLEX. Jacob Bigeleisen, Fritz S. Klein, Ralph E. Weston, Jr., and Max Wolfsberg (Brookhaven National Lab., Upton, N. Y.). *J. Chem. Phys.* **30**, 1340-51(1959) May.

The relative rates of reaction of  $\text{H}_2$  and HD with

chlorine atoms have been measured over the temperature range of  $243$ – $350^\circ\text{K}$ . In this temperature interval, the ratio of the second-order rate constants,  $R = k_{\text{H}_2}/\Sigma k_{\text{HD}}$ , is equal to  $(1.24 \pm 0.03) \exp(490 \pm 6/RT)$ . A search was made for HD after an unequilibrated mixture of  $\text{H}_2$  and  $\text{D}_2$  was half converted to hydrogen chloride by photochemical reaction with  $\text{Cl}_2$ . From the failure to detect 0.02% HD in the unreacted hydrogen, a lower limit is set for the ratio of the rate constants of the reactions  $\text{H} + \text{Cl}_2 \rightarrow \text{HCl} + \text{Cl}$  and  $\text{H} + \text{HCl} \rightarrow \text{H}_2 + \text{Cl}$ . It is shown that the pre-exponential factors in  $R$  for the HD experiments and in the analogous experiments on HT are in quantitative agreement with theoretical calculations for either linear or triangular transition states, subject to the sole restriction that  $k(\text{HD} + \text{Cl} \rightarrow \text{HCl} + \text{D})$  is approximately equal to  $k(\text{HD} + \text{Cl} \rightarrow \text{DCl} + \text{H})$ . An intercomparison is made between the experimental difference in activation energies between  $\text{H}_2$ , HD, HT, and  $\text{D}_2$  for reaction with chlorine atoms and theoretical calculations for linear and triangular transition states. With the most favorable potential function for  $\text{H}_2\text{Cl}$ , the maximum deviation between  $\Delta E_{\text{exp}}$  and  $\Delta E_{\text{theor}}$  is fifteen percent. Inasmuch as there are more experimental data than parameters necessary to construct the potential function of  $\text{H}_2\text{Cl}$ , the agreement between theory and experiment constitutes a positive test of the transition state formulation of the effect of isotopic substitution on the rates of chemical reactions. (auth)

#### 14941

SEPARATION OF THE HYDROGEN ISOTOPES BY PREFERENTIAL ADSORPTION AT  $20.4^\circ\text{K}$ . David White and W. J. Haubach (Ohio State Univ., Columbus). *J. Chem. Phys.* **30**, 1368-9(1959) May.

An approximate treatment of experimental data on ortho-para  $\text{H}_2$  separation by preferential adsorption is made to show that large isotope separations can be obtained and the magnitude of separation factors can be accounted for purely from thermodynamic considerations when only quantum zero effects are considered. (T.R.H.)

## TECHNOLOGY

### Raw Materials

#### 14942 NP-7534

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

DETERMINATION OF KEROSENE ENTRAINMENT LOSSES IN THE SOLVENT EXTRACTION OF A LEACH LIQUOR. Christian M. Lapointe. Sept. 23, 1958. 20p. (R-25).

The entrainment losses of kerosene in the barren raffinate, in the course of the solvent extraction of uranium from a leach liquor, were determined by the addition of  $\text{C}^{14}$ -labeled decane to the circuit. The toluene extract of the raffinate was made the main constituent of a liquid scintillator in which the carbon activity was measured by means of a single channel beta-ray spectrometer. An average value of 33 ppm kerosene was found in the raffinate. (auth)

#### 14943 NP-7535

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

EFFECT ON REAGENT CONSUMPTION OF RE-



CYCLING SOLUTIONS IN THE WEAK ACID LEACHING OF A URANIUM ORE. V. M. McNamara and W. A. Gow. Nov. 14, 1958. 23p. (R-28).

An investigation was carried out to study the possibility of reducing the acid requirements in the leaching of uranium ores at controlled pH, by recycling a portion of the leach liquor as make-up solution with fresh ore. The work was carried out on a laboratory scale on a siliceous ore. Ore fineness, and quantity of oxidizing agent (sodium chlorate) added, were the two variables investigated. Acid consumption at pH 1.8 was reduced from 44.2 pounds per ton for the standard leach without recycling to 38.7 pounds per ton with recycling when the ore was ground to 75 to 80 percent minus 200 mesh, and, in the same comparison, from 37.3 pounds per ton to 29.7 pounds per ton when the ore was ground to 40 to 50 percent minus 200 mesh. Recycling also permitted a reduction of the amount of sodium chlorate required, for satisfactory leaching, from 3.0 to 1.5 pounds per ton. However, reducing the sodium chlorate reduced the amount of acid saved by recycling. Recycling had no significant effect on the amount of uranium extracted. (auth)

14944 NP-7537

Canada. Dept. of Mines and Technical Surveys. Mines Branch.

SOME SOLUBILITY STUDIES IN THE SYSTEM THORIUM CARBONATE-SODIUM CARBONATE-SODIUM BICARBONATE-SODIUM SULPHATE-WATER. J. C. Ingles and F. J. Kelly. Oct. 8, 1958. 12p. (R-32).

The solubility of the thorium pentacarbonate complex has been determined in aqueous solutions containing about 10% total carbonate (carbonate: bicarbonate ratio varied from 7:3 to 3:7) and 0 to 10% sodium sulfate at 25° and at 53°C. The  $\text{ThO}_2$  solubility in all cases is of the order of 15 g/l at 25°C and 35 g/l at 53°C. At room temperature, it is slightly decreased as the sodium sulfate concentration is increased. The solid phase in

equilibrium with these solutions is  $\text{Na}_8 \text{Th}(\text{CO}_3)_5 \cdot \text{XH}_2\text{O}$ . (auth)

14945 ORNL-2709

Oak Ridge National Lab., Tenn.

URANIUM EXTRACTION BY TRI-n-OCTYLAMINE SULFATE. Kenneth A. Allen. June 4, 1959. 23p. Contract W-7405-eng-26. \$0.75(OTS).

The extraction of uranium from acidic sulfate aqueous systems by benzene solutions of tri-n-octylamine sulfate was studied under various conditions of uranium loading, acid activity, sulfate ion concentration, and amine concentration. The data are consistent with the reaction  $n\text{RH}_2\text{SO}_4 + n(1-x)/2 \text{R}_2\text{H}_2\text{SO}_4 + \text{UO}_2\text{SO}_4 = \text{R}_n\text{H}_n\text{UO}_2(\text{SO}_4)_{n/2+1} + nx/2 \text{H}_2\text{SO}_4$ , where  $\text{R} = (\text{C}_8\text{H}_{17})_3\text{N}$ ,  $x = [\text{RH}_2\text{SO}_4]/([\text{RH}_2\text{SO}_4] + 2[\text{R}_2\text{H}_2\text{SO}_4])$ , and  $n$  is the number of equivalents of amine per mole of uranium in the complex. Under conditions of constant acid activity, amine concentration, and low uranium loading, the distributions observed at varying aqueous sulfate levels lead to the following estimates of the formation quotients for the aqueous complexes  $\text{UO}_2\text{SO}_4$  ( $K_1$ ) and  $\text{UO}_2(\text{SO}_4)_2$  ( $K_2$ ) at unit ionic strength:  $K_1 = 34(17-135)$ ,  $K_2 = 200(100-760)$ ,  $K_2/K_1 = 6.0 \pm 1.0$ . (auth)

14946

CONCENTRATION OF RADIOACTIVE ORES BY ELECTRONIC METHODS. Martin Angel Garcia Corral. *Energia nuclear (Madrid)* 3, No. 9, 53-61(1959) Jan.-Mar. (In Spanish)

The use of the radioactivity of uranium ores in the concentration of the ores is discussed. The electronic method, by which the gamma radiation of the ores passing detectors is converted into electrical impulses and the ore is rejected or accepted for further treatment on the pulse height, is described in some detail. The limitations of this method are considered, and the types of ores which can be concentrated by this method are reviewed. (J.S.R.)





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